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ABSTRACT

These selected readings are designed to supplement James Gillespie's "Modern Livestock and Poultry Production" (2nd edition) as the the student reference for the advanced dairy unit. Readings are provided for 18 lessons. Topics include profitability of the dairy enterprise; production costs for dairy; comparative advantages of dairy; milk secretion; milking and sanitation procedures; dairy record and testing systems; marketing milk; marketing dairy replacements; local, state, and federal regulations for dairy; matching production to marketing; government programs for dairy; dairy associations and organizations; selecting breeding animals; reproductive management; facilities and equipment; dairy herd health programs; feeding dairy animals; and using pasture and roughage. (YLB)

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Advanced Dairy Unit

for

Advanced Livestock Production Curriculum

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Selected Readings

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Selected Readings

ADVANCED DAIRY UNIT

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This Advanced Dairy unit, part of the Advanced Livestock Production curriculum, represents a major revision of the previous guide. Its modification was suggested by the Teaching Aids Committee of the Missouri Vocational Agriculture Teachers Association.

Special thanks are due to Dairy Advisory Committee members for providing their valuable time and suggestions in developing this unit. The committee consisted of Jim Bellis, Kerry Kephart, Dean Swafford, Eddie Fugate, Leonard McGee, Rex Ricketts and Alan Wessler.

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FOREWORD

This selected readings is designed to supplement James Gillespie's Modern Livestock and Poultry Production, 2nd ed., as the student reference for the Advanced Dairy unit. It will also be of value to those seeking a more in-depth understanding of a dairy enterprise.

Missouri is in a good position to become a more important dairy state, despite nationwide overproduction. The state ranks in the top 10 in at least nine categories measured by the U.S. Statistical Reporting Service. In the last 25 years, Missouri producers have made rapid progress toward increased milk production per cow.

Persons using this selected readings on an individual basis may wish to secure a copy of the instructor's guide for additional materials on dairy management.

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ADVANCED DAIRY

TABLE OF CONTENTS

ACKNOWLEDGMENTS ii

FOREWORD iii

Lesson 1--Profitability of the Dairy Enterprise 1

Dairying Advantages in Missouri 1
Start-up Factors to Consider 2
Comparative Profitability 2

Lesson 2--Production Costs for Dairy 4

Production Costs 4
Income Potential of Grade A vs. Manufacturing-Grade Milk 4
Leasing in a Dairy Enterprise 4
Maintaining Herd Health 4

Lesson 3--Comparative Advantages of Dairy 6

Grade A vs. Manufacturing-Grade 6
Dry Lots and Automation 6
Pasture Grazing 8
Raising Replacements 9
Major Facility Costs 9

Lesson 4--Milk Secretion 11

Sequence of Milk Let-Down 11
Lactation Conditions and Disease Control 11

Lesson 5--Milking and Sanitation Procedures 13

Grade A Minimum Standards 13
Manufacturing-Grade Milk 13
Sanitation Procedures for Processing Milk 13
Water Hardness 15

Lesson 6--Dairy Record and Testing Systems 16

Interpreting DHI Reports 16
Interpreting Pedigrees 19
Sample Day and Lactation Report 20
Herd Summary 21

Lesson 7--Marketing Milk 22

Marketing Options 22
Component Pricing 22
Premiums for Quality Milk 22
Non-Traditional Dairy Products 23

Lesson 8--Marketing Dairy Replacements 25

Markets for Replacements 25
Recordkeeping for Dairy Replacements 25
Registered vs. Grade 25
Advertising and Promotion 25

Lesson 9--Local, State and Federal Regulations for Dairy 27

Animal Health Regulations 27
Farm Inspection 27
Processing Plant Tests 27
Waste Management Regulations 28
Sample Inspection Report 29

Lesson 10--Matching Production to Marketing 30

Seasonal Peaks and Demands 30
Measuring Somatic Cells 30
Mastitis Affects on Production 30
"Reproductive Dairy Herd Health Program--Routine Examinations" (G3011) .. 32

Lesson 11--Government Programs for Dairy 34

Price Supports 34
Effects of Government Programs 35
Imports and Exports 35
Lobbying Efforts 36

Lesson 12--Dairy Associations and Organizations 37

Dairy Organizations 37
Breed Associations 38

Lesson 13--Selecting Breeding Animals 39

Cow Index Development 39
Using Cow Indexes to Select Replacements 39
Linear Classification 39
Sire Selection for Artificial Insemination 40
Holstein Recording Worksheet 42
Description of Traits and Measurement Scale 43

Lesson 14--Reproductive Management 44

Artificial Insemination 44
Embryo Transfer 44
Reproductive Health Programs 45
Reproductive Technology 45

Lesson 15--Facilities and Equipment 48

Waste Handling 48

Lesson 16--Dairy Herd Health Programs 51

Categories of Dairy Diseases 51
Vaccination Recommendations 51
Mastitis Control 51
Diseases Affecting Humans 52

Lesson 17--Feeding Dairy Animals 53

Purpose of a Forage Analysis 53
Sampling Forages 53
Interpretation of a Forage Analysis 53
Home-mixed vs. Commercially Mixed Rations 55

Lesson 18--Using Pasture and Roughage 58

Forage Alternatives 58
Pasture Selection 59
Buying Roughage 59
Forage Equipment 60

Dairying Advantages in Missouri

Opportunities are great for Missouri to become increasingly important in dairying, despite overproduction nationwide. Missouri ranks in the top 10 in at least nine categories measured by the U.S. Statistical Reporting Service. Missouri ranks among other dairy states as follows:

* 5th in hard milk
* 6th in number of milk cow farms
* 7th in total cheese production
* 8th in cheddar cheese
* 8th in whole milk used in manufacturing
* 9th in creamed cottage cheese production
* 9th in production of cottage cheese
* 10th in number of dairy cows
* 10th in production of ice milk

More progress toward increasing milk production per cow has been made in Missouri in comparison to eight surrounding states. Missouri's milk production in 1964 (fifth in the area) was 6,670 pounds of milk per dairy cow. With a current average of 12,371 pounds of milk per cow, Missouri now ranks first among the eight neighboring states.

The following are some of the advantages Missouri has as a dairy state.

Location - Missouri is in an excellent location for dairying. The high usage areas of fluid milk in the U.S. are in the south and southeast. Fluid milk reaps the highest price per cwt because of perishability and demand. The population centers in southern states cause increased milk consumption and importation. Missouri's location near these markets allows Missouri dairymen to take advantage of these southern markets.

Forage production - Missouri has the land and soil potential for producing quality forage. Since a lactating cow's diet is 50% forage, a must for high milk production is quality forage. Missouri farmers have demonstrated that they can do an excellent job of producing high-quality forages, including alfalfa. Land going into the conservation reserve program in the northern part of the state, as well as limited acreage in southwest Missouri, has tremendous potential for quality forage production.

Transportation costs - Costs of hauling milk and equipment in Missouri are kept low as long as there remains a critical core of dairy producers throughout the state.

Climate - Missouri's climate is conducive to good animal performance. The climate also allows for the utilization of pasture programs and reduced costs in raising heifers and keeping dry cows.

Land prices and taxes - Missouri's land prices and taxes are much lower than those in many other states. The 1986 average value of land in Missouri was

$606 per acre. Although most businesses will not make a decision to relocate based primarily on the cost of land, it is certainly an important consideration because of repayment opportunity, interest and taxes.

Alternative feeds - Missouri is in one of the best locations in the U.S. for alternative feeds. These feeds are rapidly becoming an economic necessity for operating dairy farms at a profit. Missouri is at the southern edge of the major corn and soybean production areas. The production of corn for corn sugar provides corn gluten feed; processing soybeans into soybean meal provides soy hulls for dairy feed. Soy hulls are high in fiber and are a good complement to high-energy corn diets. Eastern Missouri's brewery industry provides wet and dry brewer's grains. These grains are a good source of protein and fiber. Other sources of alternative feeds throughout the state are cotton (cottonseed feed), rice (rice bran), wheat (wheat middlings) and distilleries (distiller's grains).

Marketing - Missouri is well represented by major milk marketing organizations. The state is the home of Mid-America Dairymen, Inc., one of the largest milk marketing cooperatives in the U.S. Other organizations include Kraft and the Associated Milk Producers Cooperative.

Educational support - Finally, Missouri has an excellent educational system to complement the production efforts of dairymen throughout the state. The University of Missouri's extension program is recognized as one of the best nationally in providing information concerning dairy science research and management to the dairy industry.

Start-up Factors to Consider

Positive factors - A lactating cow's diet can consist of 50% forages, and Missouri is strong in forage production. Dairying provides a steady income throughout the year, and labor is used throughout the year. Death losses in the dairy herd are usually low if good management is followed.

Negative points - A high capital investment is required. The labor requirement is high, and the operator is confined to a regular schedule of milking. Training and experience are needed before entering into the dairy business. It takes a relatively long time to develop a high-producing dairy herd.

Comparative Profitability

The following data is based on results of the University of Missouri studies (Farm Business Management Analysis for 1981-85 and 1985 Mail-In-Record {MIR} Program). These results cannot be considered representative of an average Missouri farm because participation is voluntary. However, it is felt the results show what can reasonably be expected on commercial farms in Missouri.

FBMA - Summary records for 1981-1985 showed that participating dairy farms had greater net farm incomes than hog or beef farms every year.

MIR - According to Missouri statistics, dairy farms were more profitable than the average of all farms for two of the five years. From 1976-1985, dairy

farms had a higher return to land, labor, capital and management than hog enterprises for five of 10 years. Compared to swine enterprises, dairies had a higher percent return to management during six of 10 years. Compared to beef enterprises, dairies showed a higher percent return to management during nine of 10 years.

Credits

Ricketts, Rex. "Missouri Makes the Grade", Missouri Dairy News, Vol. 1, No. 4. Columbia: Missouri Dairy Association, Missouri Dairy Herd Improvement Federation and UMC Dairy Science Dept., December 1986.

Farm Business Management Analysis Summary of Records. University of Missouri-Columbia: Agricultural Education, 1985.

Production Costs

Major costs for a dairy enterprise include feed such as grain, silage and green chop, hay or haylage and pasture. Labor costs involve those for the operator, the operator's family and hired help.

Operating or variable costs consist of the purchase, repair or hiring expenses for machinery and equipment, veterinary care and medicine, livestock supplies and hauling, utilities, insurance, property and sales taxes, repairs and operating interest.

Overhead or fixed costs are made up of real estate, depreciation and interest on buildings; cow herd interest; and interest and depreciation on machinery and equipment.

Income Potential of Grade A vs. Manufacturing-Grade Milk

Milk retailers have observed that increased quality stimulates consumption, and consumers are willing to pay higher prices for milk of high quality. Superior quality can stimulate demand for milk. Processors and dairies pay premium prices for high-quality milk. Some cases show prices as high as $2 per hundredweight. Added income from high-quality milk of a 40-cow herd producing an average of 10,000 lbs. can be $7,000-$8,000 yearly.

Leasing in a Dairy Enterprise

Dairy farmers may have limited available capital. They may also be limited on the amount of capital they can borrow. Leasing is a method of using additional capital without disturbing present sources of credit.

Leasing has distinct benefits to farmers. It can increase their number of cows to make greater use of available labor, management and facilities. Producers can acquire higher-producing cows than present sources of credit might allow. They may receive services and advice from cow-leasing firms.

Leasing agreement standards are agreed upon by both the owner and the producer. The dairy farmer acquires the use of a dairy cow by making periodic payments to the person or firm granting the lease. Ownership rights of the cow remain with the lessor. The lessee has possession and the right to all milk receipts.

Maintaining Herd Health

Mail-In Record averages of 1981-85 shows the following cost results (Table 2.1). Veterinary and medicine expenditures to produce 100 pounds milk equivalent are given in percent of variable costs.

TABLE 2.1 - Veterinary and medicine costs

By farm type		
Farms where dairy is the major enterprise	2.1%	
All farms where dairy production occurs		
Fewer than 50 cows	2.3%	
50-70 cows	2.1%	
More than 70 cows	2.0%	
By milk produced per cow		
10,000-12,000 pounds	1.7%	
12,000-14,000 pounds	2.0%	
More than 14,000 pounds	2.5%	
Per mature cow		
Average of all herds		$39.40
Producing 10,000-12,000 pounds of milk		27.80
Producing 12,000-14,000 pounds of milk		36.80
Producing more than 14,000 pounds of milk		54.40

Dairy producers need to be aware of practices which help prevent and control disease, such as providing good care and adequate shelter; feeding a proper ration; purchasing only disease-free stock; removing diseased animals from the herd; guarding against disease carriers; selecting disease-resistant stock; keeping facilities and equipment clean; and planning programs for vaccination, disease-testing and routine parasite control.

Credits

Bennett, Myron. Farm Management Newsletter. University of Missouri-Columbia: Department of Agricultural Economics, August 29, 1986.

"Buy or Lease Dairy Cows" (G430). University of Missouri-Columbia: Extension Division, 1985.

Grade A vs. Manufacturing-Grade

Table 3.1 shows the ratio of Grade A milk produced as compared to manufacturing grade. When deciding whether to produce Grade A or manufacturing-grade milk, the producer must take into consideration the price difference between the two grades and several other factors.

Grade A milk sells for a higher price per cwt than manufacturing-grade milk, but production regulations are comparable for both grades. Current somatic cell count regulations are the same, and milking barn standards are very similar. Bacteria counts can be higher for manufacturing milk than for Grade A.

Cow herd management practices are the same for both grades. Rations need to be balanced to meet daily needs. Herd health programs need to be maintained. Recordkeeping programs are essential, regardless of the grade produced.

TABLE 3.1 - Milk sold to plants and dealers

	Marketings (million lbs.)			Percent
Year	Total	Manufactur-grade	Fluid grade	fluid grade
1965	112,720	34,943	77,777	69
1967	109,433	32,830	76,603	70
1969	108,497	29,294	79,203	73
1971	112,201	26,928	85,273	76
1973	109,823	25,259	84,564	77
1975	110,240	22,048	88,192	80
1977	118,172	21,271	96,901	82
1979	119,440	19,110	100,330	84
1981	129,237	19,386	109,851	85
1983	136,090	19,053	117,037	86
1985	139,937	18,192	121,745	87

Credit: 1986 Dairy Producer Highlights. Arlington, Va.: National Milk Producer Federation.

Producers with facilities that require little remodeling may choose to produce manufacturing milk because the initial start-up investment is small. Producers without facilities or those that require costly remodeling may find it profitable to design Grade A facilities from the beginning in order to sell their product at a higher price.

Dry Lots and Automation

The number of U.S. dairies is decreasing. Refer to Tables 3.2 and 3.3 for statistics on this trend. What could be some reasons behind this tendency? How are fewer dairy farmers meeting the increased labor and management demands of larger herds?

TABLE 3.2 - Total number of farms and farms with milk cows, 1900-82

Census of	Farms reporting milk cows	
	Total (1,000)	Ave. herd size (number)
1900	4,514	3.8
1910	5,141	3.3
1920	4,461	4.4
1930	4,453	4.6
1940	4,644	5.2
1950	3,648	5.8
1955	2,936	6.9
1960	1,792	9.2
1965	1,134	12.9
1969	566	19.8
1974	414	25.7
1978	312	32.8
1982	278	39.1

Credit: 1986 Dairy Producer Highlights. Arlington, Va.: National Milk Producers Federation, p. 4.

Automation and dry lots are two means of increasing the efficiency of dairy production; their use swaps equipment use for labor needs. A 1985 summary by the Missouri Dairy Herd Improvement Association indicated that pasture usage in Missouri declined steadily since 1976. In 1985, 97 of 735 producers did not utilize pastures.

Dry lots - Dry lots give the producer higher forage utilization since less forage is wasted by trampling and cattle are less selective when consuming forage. Feed intake and utilization is optimized, as well. Maximum utilization can be made of automatic concentrate feeders since cows with ready access to them consume more and do not expend energy foraging on pasture. Dry lots also reduce time requirements, improve observation during calving or health examinations and increase control over the total operation.

With dry lots, there are also drawbacks to be considered. Dry lot operations require higher facility costs for a comfortable loafing barn and adequate corral system. Equipment costs are higher because of forage harvesting and handling equipment, added storage facilities and automatic feeders. Lameness can result if cattle are confined entirely on concrete, and heat detection can be more difficult.

Automation - The primary benefit of automation is a reduced labor need. Using a pipeline system to transport milk eliminates carrying and handling the milk. Feeding systems can be installed that provide a specific amount of feed to each cow. Equipment used to handle bulky feeds include silo unloaders, bunk feeders and self-propelled electric feed carts. Grains are usually easy to move with augers and conveyers. Automatic milker machine take-off units and additional milking stalls can help a producer milk more cows in the same

amount of time. The milking parlor can be insulated, heated, ventilated or air-conditioned according to the climate.

TABLE 3.3 - Farms reporting milk cows by herd size, 1959-74*

Herd size	1959	1964	1969	1974
	(1,000)			
1-19	1,706	947	402	153
20-29	149	121	80	47
30-49	94	108	92	71
50-99	30	40	43	46
100 plus	7	10	11	14
Total	1,986	1,226	628	331
	(% distribution)			
1-19	85.9	77.2	64.1	46.2
20-29	7.5	9.9	12.7	14.2
30-49	4.7	8.8	14.6	21.5
50-99	1.5	3.3	6.8	13.9
100 plus	.4	.8	1.8	4.2
Total	100.0	100.0	100.0	100.0

*Excludes Alaska and Hawaii.

Credit: 1978 Dairy Producer Highlights. National Milk Producers Federation, p. 3.

Pasture Grazing

Increased dairy automation has affected pasture grazing of the dairy herd. Producers must weigh land costs with other factors in deciding whether pasture grazing will be efficient for their operation.

Pastures can lessen feed costs since forage is cheaper than harvested and stored hay or silage. Pastures can also lessen the occurrence of communicable diseases and reduce the hazard of nutritional deficiencies by providing a good source of high quality protein, vitamins and minerals.

Using pastures diminishes costs for buildings and equipment. Pastures allow for greater flexibility where renters are involved or where uncertainties exist with a long-range program. Depending upon the type of pasture system, using pastures may not require high-level management skills on the part of the dairy farmer. Reproduction can be improved through exercise and improved heat detection (if the herd is watched).

Pastures help conserve soil on rolling land and maximize the use of non-crop areas. The advantages of pastures can be multiplied if more intensive management is applied, such as interseeding legumes like red clover or alfalfa into existing grass stands, destroying tall fescue infected with endophyte fungus, maintaining adequate soil fertility and developing a grazing management plan.

Raising Replacements

The cost of a replacement heifer is a major consideration when deciding whether to purchase or raise replacements. Refer to Table 3.4 for some costs involved in raising replacements.

TABLE 3.4 - Costs other than feed for raising calves to 24 months

Item	Cost per calf
Three-day-old calves	$100.00
Labor (55 hours at $2.50/hour)	137.50
Buildings and equipment, machinery, etc.	14.55
Bedding	11.25
Veterinary and medical expenses	5.00
Breeding ($10/insemination x 2 services/conception)	20.00
Utilities	1.35
Insurance	3.25
Mortality cost	15.10
Miscellaneous	7.83
Interest on above costs at 8% (over 24 months)	33.17
Total	$349.00

Credit: Jones, G. M. "Dairy replacement heifers, the cost of raising them and their value," Dairy Guidelines, Series 291. Blacksburg, Va.: Virginia Polytechnic Institute and State University.

The total cost of raising replacement heifers to 24 months of age ranges from $700 to $800 per animal. Feed costs account for 50-58% of the cost of raising replacements. Dairy farmers can save money when raising replacements by feeding calves milk replacer or pickled colostrum and using improved pasture for seven months of the year.

Dairy farmers raise heifers for their own use or for others to purchase. Business aspects must be considered; producers intend to earn a profit by selling replacement heifers. Raising replacements eliminates unknowns and gives additional facts and control over such areas as health status, age, pedigree, sire selection and genetic potential. Transportation stress and the cost, time and effort required to locate good replacements is also eliminated by raising replacements.

Major Facility Costs

Economical dairy production depends largely on the investment in practical buildings and equipment, as well as the care, feeding and management of the herd. For facility cost estimates, refer to the information below and in Lesson 15.

The price range for milking barns or parlors is $5,200-$22,000 for singles and $20,000-$40,000 for a double-four barns. Depending on whether it is purchased used or new, milking equipment will cost $10,000-$30,000. New bulk tanks are

about $10 per gallon and can usually be purchased cheaper used. Other items might include the following.

TABLE 3.5 - Facility costs

Water conditioner	$ 500- 600
Cleaning in-place unit	40- 60
High-pressure water pump (for cleanup)	350- 425
Alternator	2,500-4,000
Bulk feed storage tank, 8.7 ton capacity	1,100-1,500
Steel pipe (per foot)	5- 9
Loafing barn (per stall)	320- 425
Utah free stalls (per stall)	175- 225
Concrete for walkways from silage or hay areas to loafing areas or parlor (per yard)	35- 40
Animal waste control facilities	100- 400
Automatic take-off units (detachers, per stall)	250-1,000
Calf raising facilities	
Individual stall or calf hutches	80- 100
Shed space after weaning	50- 60

Credits

Baker and Greer. Animal Health - A Layman's Guide to Disease Control. Danville, Ill.: Interstate, 1980.

Ensminger, M. E. Dairy Cattle Science, 2nd ed. Danville: Interstate, 1980.

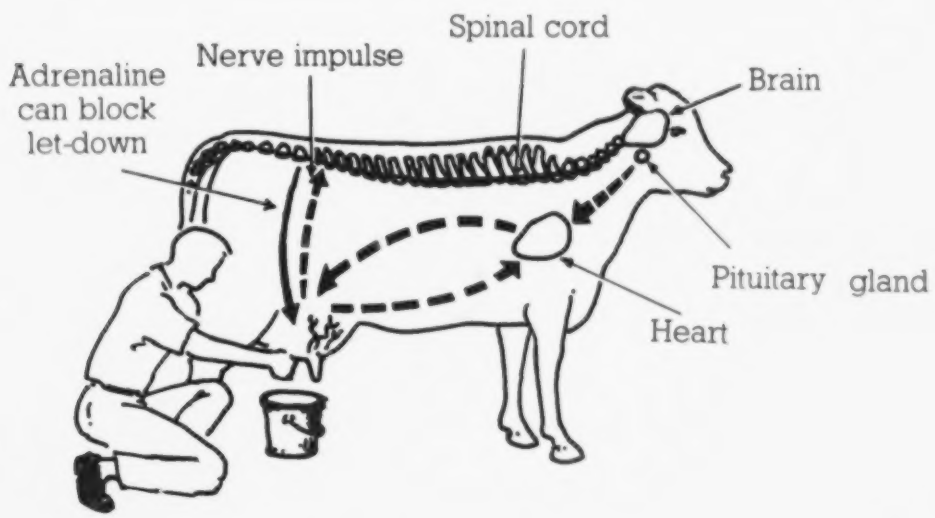
University of Missouri-Columbia Extension Division agricultural publications

a) G3555: Raising Calves on Stored Colostrum (1976)
b) G3556: Raising Dairy Replacements (1985)
c) M75: Missouri Farm Planning Handbook (1986)

Sequence of Milk Let-down

The udder is stimulated by a calf or a milker. Nerve impulses are conducted to the pituitary at the base of the cow's brain, which releases the hormone oxytocin into the bloodstream. Oxytocin, the milk let-down hormone, causes contraction of the tiny, muscle-like cells surrounding each alveolus, forcing milk into the large ducts and cisterns of the udder. When a cow is frightened or angry, milk let-down is interrupted by action of the hormone adrenalin, which constricts udder blood vessels.

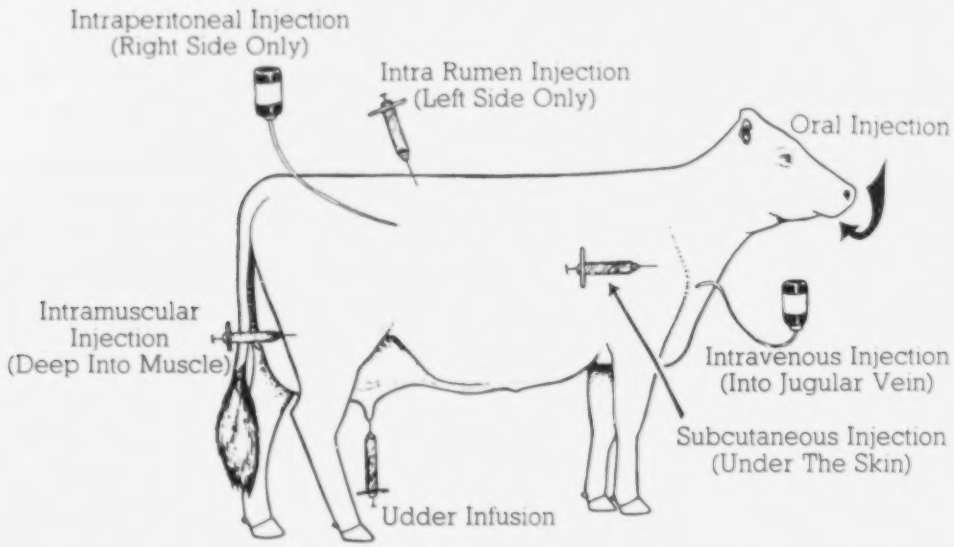
FIGURE 4.1 - Milk let-down steps



Lactation Conditions and Disease Control

Various conditions affect milk production, such as ketosis, milk fever, udder edema and mastitis. Udder edema may be caused by a reduction of blood proteins and increased blood flow at calving time. It is characterized by an accumulation of fluid in the intercellular spaces of the udder and those spaces forward of the udder. Severity is increased by a high intake of sodium chloride or potassium chloride (salts). For information on other lactation conditions, refer to Unit 42: Dairy Herd Health in Gillespie's Modern Livestock & Poultry Production.

FIGURE 4.2 - Injection areas



From Unit IV, "Maintaining Animal Health", Nebraska Basic Core Curriculum II.

Credits

Ensminger, M. E. Dairy Cattle Science, 2nd ed. Danville: Interstate, 1980, pg. 455.

Dairy Production (Student Reference). University of Missouri-Columbia: Instructional Materials Laboratory, 1982, pg. 20.

Extensive federal and state laws have been established to police the quality of milk that is available for consumers. These regulations detail chemical, bacteriological and temperature standards for milking and processing of dairy products. In order to successfully market milk, the producer must be aware of these guidelines.

Grade A Minimum Standards

Temperature - Cool to 45F or less within two hours after milking; the blended temperature after the first and subsequent milkings should not exceed 50F.

Bacterial limits - Individual producers' milk must not exceed 100,000 bacterial count per milliliter before it is mixed with other producers' milk. The count from several producers' mixed (commingled) milk must not exceed 300,000 prior to pasteurization.

Somatic cell count - Individual producer's milk cannot exceed a somatic cell count of 1,500,000 per milliliter.

Other requirements - These include no addition of water, freedom from antibiotics and pesticides, exclusion of milk from diseased animals (including mastitic cows) or milk which contains colostrum, and proper construction and maintenance of the milking parlor and related facilities.

Manufacturing-Grade Milk

Sight, flavor and odor - The flavor and odor should be fresh and sweet. Milk should be free of off-flavors and off-odors that adversely affect the finished product. It should show no abnormal condition (curdled, ropy, bloody or mastitic) as indicated by sight and odor.

Sediment content - The maximum is 2.5 milligrams per pint.

Bacterial limits - A maximum bacterial count of 1,000,000 per milliliter is allowed.

Somatic cell count - The maximum is 1,000,000 per milliliter (effective Jan. 1, 1988.

Other requirements - Producers must participate in USDA programs for brucellosis and tuberculosis control. The sale of abnormal milk (that containing antibiotics, pesticides or other chemical residues in excess of established limits or from cows with mastitis) is prohibited.

Sanitation Procedures for Processing Milk

The following sanitation practices are used in processing Grade A raw milk for pasteurization. Plants that process manufacturing-grade milk are subjected to general sanitation requirements similar to those for plants processing Grade A milk. Additionally, there are supplemental requirements for plants that

process dry milk products; butter and related products; evaporated, condensed or sterilized milk products; and cheese.

Using water - Water for milking operations should be from a supply that is properly located, protected and operated. Adequate water should be easily accessible and of a safe, sanitary quality.

Maintaining clean equipment - All multi-use containers, equipment and utensils used in the handling, storage and transportation of milk should be made of smooth, nonabsorbent, corrosion-resistant, nontoxic materials and should be constructed to allow for easy cleaning. The product-contact surface of all multi-use containers, equipment and utensils should be sanitized before and cleaned after each usage.

Using single-service articles - Articles intended for single-service use should not be reused.

Storing equipment - All containers, utensils and equipment used in handling, storing or transporting milk--unless stored in sanitizing solutions--should be stored to assume complete drainage and should be protected from contamination prior to use.

Handling equipment - After sanitization, all containers, utensils and equipment should be handled to prevent contamination of any product-contact surface. Sanitized product-contact surfaces should be protected against contact with unsanitized equipment and utensils, hands, clothing, splash, condensation and other sources of contamination. Any sanitized product-contact surface which has been exposed to contamination should be cleaned again and sanitized before use.

Locating equipment and operations - Equipment and operations in the milking parlor should be located to help prevent both overcrowding and contamination of cleaned and sanitized containers, equipment and utensils by splash, condensation or manual contact.

Protecting milk - During processing, pipelines and equipment used to contain or conduct milk and milk products should be effectively separated from tanks or circuits containing cleaning and/or sanitizing solutions. All product-contact surfaces should be covered or otherwise protected to prevent the access of insects, dust, condensation and other contamination. Milk storage receptacles should be raised above the floor or placed at a distance from the cows to prevent contamination by manure or splashing.

Storing antibiotics - Antibiotics and medicines should be carefully stored to prevent contamination of milk or milk product-contact surfaces of the equipment, containers or utensils.

Maintaining personal cleanliness - Adequate hand-washing facilities should be provided, including a sink with running water, individual sanitary towels and soap or detergent. Hands should be washed clean and dried with an individual sanitary towel immediately before milking, before performing any milk parlor function and immediately after the interruption of any of these activities.

Milkers should wear clean outer garments while milking or handling milk, milk containers, utensils or equipment.

Cooling milk - Raw milk for pasteurization should be cooled to 45F or less within two hours after milking; the blended temperature after the first milking and with subsequent milkings should not exceed 50F.

Water Hardness

Water hardness is expressed as the amount of calcium and magnesium salts present in milligrams per liter, or grains per gallon. Table 5.1 expresses water hardness in relative terms.

TABLE 5.1 - Concentration of hardness components

Water conditions	mg/liter	grains/gal.
Soft	0-60	0-35
Medium	60-120	3.5- 7.0
Hard	120-180	7.0-10.5
Very hard	>180	>10.5

Temporary hardness caused by bicarbonates, the usual factor in hardness difficulties, is removed from water by heat and most alkaline materials. Components of water involved in permanent hardness are chiefly the sulfates and chlorides of calcium and magnesium. They are precipitated by many alkaline materials but not by heat. In addition, soluble iron and manganese oxides in well-water supplies are troublesome because they produce reddish-brown stains.

Constituents of water that break down under alkaline conditions and/or on heating cause problems associated with cleaning. In heat exchangers such as pasteurizers and coolers, lime deposits decrease the efficiency of heat transfer. These deposits must be removed. Salts that build up on equipment leave films in which fat, protein and other milk components combine to form milkstone. It is important, therefore, to soften water used for cleaning.

Credits

Campbell, John R.; Robert T. Marshall. The Science of Providing Milk for Man. N.Y.: McGraw-Hill, 1975, pg. 567.

"Grade A Pasteurized Milk Ordinance: 1978 Recommendations. "Public Health Service; FDA; U.S. Dept. of Health, Education and Welfare.

"Milk for Manufacturing Purposes and its Production and Processing," Recommended Requirements, Federal Register. Washington, D.C.: Consumer and Marketing Service, U.S. Dept. of Agriculture. Vol. 37, no. 68. April 7, 1972.

Interpreting DHI Reports

The Dairy Herd Improvement Association (DHIA) is a cooperative milk-testing and recordkeeping program for dairy cows which is sponsored by the USDA and the Cooperative Extension Service at several state colleges of agriculture. This summary refers to the sample reports at the end of this lesson.

SAMPLE DAY AND LACTATION (DHIA-200)

Section I - The top two lines of the report contain identification and administrative information used by the processing center to keep track of each herd and each report.

Section II - Information in this section is used for cow identification.

Section III - This information indicates the amount of production on the sample day.

Pounds of milk and percent fat produced data can be used as culling criteria. It is important to realize that percent fat is also used to determine feed needed and the price paid for milk.

Income over feed cost information is an important tool in culling unprofitable cows. Notice how differences in pounds of milk and percent fat affect income over feed cost. This number can also be misleading if the producer does not accurately estimate the cost of the feed, which usually makes up 40-50% of all milk production costs.

In the grain mix fed and needed columns, note that overfeeding grain can be costly in wasted feed and over-conditioned cows. Underfeeding may cause cows to produce less milk than they are capable of producing or it may cause a serious loss of body weight. A producer should use this data, along with visual appraisal, to determine the optimum amount of grain to feed.

Section IV - Providing identification and up-to-date information about the cow's current lactation, the producer can summarize a cow's profitability for her lactation.

The days dry figure can usually be used to identify cows with reproductive problems. The cow's age can possibly be used to select for longevity in offspring; however, this is a lowly heritable trait. Number of days in current lactation figures can be used to determine cows with reproductive problems, especially noting unusually long lactations. An optimum lactation length is 305 days.

Total pounds of milk, fat and percent fat can be analyzed to determine an individual's persistency. Persistency data indicates whether or not the cow's lactation curve is holding up better than the average for her breed, age and season of freshening.

Income over feed cost information takes into account the dry period of the cow. The record, beginning with a dry date, is negative until the value of production exceeds the feed cost for the dry period and for the lactation to-date.

Section V - The producer is provided with information for making culling and breeding decisions.

In the 305-2X-M.E. column, the current lactation is standardized to a 305-day length, to twice-a-day milking, to a mature equivalent basis and to an average freshening month. The producer can use this information to compare cows of different ages that freshen at different seasons and have milked a different number of days.

Producers can use the difference in herdmates figures for culling as these figures compare herdmates on a standardized basis.

Due dates, action needed or service sires columns are used to determine breeding information such as when cows will freshen, should calve, should be bred and what bull was used.

Section VI - Information on a string or the entire herd is given in this section.

The percent protein needed figure is based on a total protein requirement for the average cow in the string or herd. Body weight figures must be fairly accurate or feeding information will not be adequate.

Section VII - Lactations are reported for individuals when they leave the herd or when they complete a 305-day or 365-day record.

HERD SUMMARY (DHIA-202)

This report can best be used by combining its data with the data on the Sample Day and Lactation Report.

Section I - This section summarizes reproductive information about the herd as of the most recent sample day.

Using sample day data, cows which were open more than 120 days should be identified. The recommended average number of open days is less than 100. Days in excess of 100 may indicate reproductive problems within the herd.

Breeding interval columns point out abnormally short and long cycles often associated with cystic ovaries and missed heats; abnormally long cycles are often caused by heat detection problems. Information on average services per conception can determine breeding problems such as poor A.I. techniques or bull reproductive problems. Average services per conception should not exceed 1.5 for optimum efficiency.

Section II - The herd summary can be useful in planning with respect to projecting goals, making culling decisions, projecting cash flow, formulating feeding programs, estimating housing needs and grouping animals.

Section III - Cow identification, herd sire, service sire, dry days and lactation data provide information helpful in evaluating the herd's genetic progress.

Sires have the greatest impact on genetic improvement in dairy herds. The predicted differences of pounds of milk, percent fat, pounds of fat and income can be very important in determining if replacements have superior producing ability. Service sire averages give information on sires used, as opposed to the sires of, the herd. It is important to use bulls with known P.D.s to ensure productivity increases.

In the dry days summary, consider that the recommended number of dry days is 45-60. Dry periods shorter than 40 days do not allow enough time for udder involution, while dry periods longer than 70 days can result in excess body condition. The most economical dry period length is 45 days. The lactation summary should indicate superiority in first-lactation females if superior sires and proper management techniques are being used.

Section IV - The birth and inventory summary contains information on offspring born in the last 365 days, any calving difficulty recorded and a record of the number of animals that entered or left the herd since the last report.

Section V - Stage of lactation summarizes the test-day production of all producing cows. This data can be used to compare the herd's production trend with the average or typical herd.

Section VI - The feeding summary contains data on feeds fed and on peak milk production, along with feeding analysis information.

As feed makes up the largest production cost, it is important that correct information be submitted for summary on the report. Summit values should be compared to determine if cows are peaking where they should in early lactation. Feed data should be analyzed to determine if protein levels are adequate in feed given and if pounds of forage D.M. per body hundredweight and pounds of milk produced per pounds grain fed fall into acceptable ranges for the feeding program and stage of production.

Section VII - Costs and returns summarize the amount of return in dollars that producers receive for their output.

Using a work sheet to determine fixed costs, net dollar return can be determined. It is important to realize that getting better may generate more income than getting bigger.

Section VIII - The production summary indicates test interval, number of producing animals, test interval daily average and rolling 365-day average. It can help identify any sudden drops or rises in production, indicating a need for management changes.

Section IX - This section gives information on new or corrected identifications.

Interpreting Pedigrees

Producers should consider production records and type classification on the cow's pedigree. Determine conditions under which the record was made, such as milking twice vs. three times daily and 305-day lactation vs. 365-day lactation. Determine if the records are actual or adjusted (pounds of milk and fat actually produced vs. mature equivalent). Mature equivalent (M.E.) is an estimated figure which predicts what the animal's production will be when mature.

Official type classifications should be studied to learn whether the individual and most of the parents and grandparents were classified and into what category they fall. NOTE: Point divisions may differ from breed to breed. The following list is for Holstein-Friesian cattle.

1. Excellent: 90 points and above
2. Very good: 85-89 points
3. Good plus: 80-84 points
4. Good: 75-79 points
5. Fair: 70-74 points

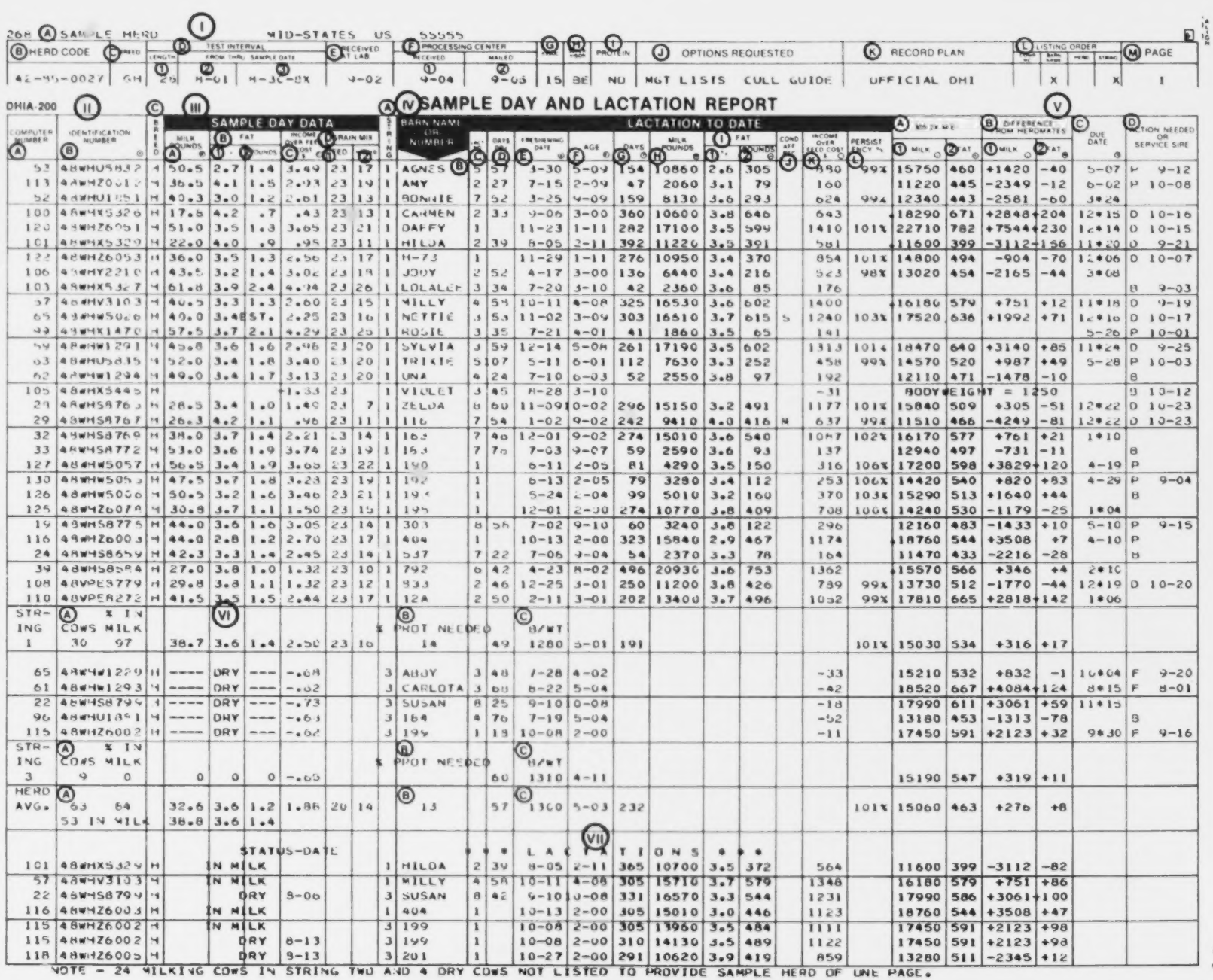
Dairymen should consider predicted difference values on sires. Predicted Difference for Milk (PDM) is the amount of milk a given sire's daughter should produce as compared to the average cow. Predicted Difference for Fat (PDF) is the amount of fat a given sire's daughter should produce as compared to the average cow. Predicted Difference for Type (PDT) is used to determine how the daughters of a given sire should score on an official type score classification, as compared to the average cow. Predicted Difference for Income (PD$) is an estimate of the dollar amount which daughters of a given sire should generate, as compared to the average individual by using PDM and PDF. Predicted Difference for Protein (%) is used to determine the expected difference in percent protein of milk from a certain bull's daughters as compared to the average. Percent Repeatability helps determine how likely the predicted difference will translate into the actual difference.

Credits

Quinn, Thomas. Dairy Farm Management. Albany: Delmar, 1980, pg. 45-53.

Guide to Using DHI Reports. Ames, Iowa: Mid-States Dairy Records Processing Center, Iowa State University.

a) "An Introduction to Dairy Herd Improvement Records"
b) "How to Interpret the Sample Day and Lactation Report (DHIA-200)"
c) "How to Interpret the Herd Summary (DHIA-202)"



26B (A) SAMPLE HERD (I) MID-STATES US 55555

(B) HERD CODE	(C) BREED	(D) TEST INTERVAL LENGTH	(D) TEST INTERVAL FROM THRU SAMPLE DATE		(E) RECEIVED AT LAB	(F) PROCESSING CENTER RECEIVED	(F) PROCESSING CENTER MAILED	(G) CASE	(H) VISIT	(I) PROTEIN	(J) OPTIONS REQUESTED	(K) RECORD PLAN	(L) LISTING ORDER TAG NO.	(L) LISTING ORDER BARN NAME	(L) LISTING ORDER HERD	(L) LISTING ORDER STRING	(M) PAGE
42-MS-0027	GH	29	M-01	M-3C-8X	9-02	9-04	9-05	15	BE	NO	MGT LISTS CULL GUIDE	OFFICIAL DHI		X		X	1

DHIA-200 (II) (C) BREED (III) (A) STRING (IV) **SAMPLE DAY AND LACTATION REPORT** (V)

COMPUTER NUMBER (A)	IDENTIFICATION NUMBER (B)	BREED (C)	SAMPLE DAY DATA: MILK POUNDS (A)	FAT % (B)	FAT POUNDS (C)	INCOME OVER FEED COST $ (D)	BRAIN MILK CODED (D)	STRING (A)	BARN NAME OR NUMBER (IV)	LACT. NO.	DAYS (D)	FRESHENING DATE (E)	AGE (F)	DAYS (G)	LACTATION TO DATE: MILK POUNDS (H)	FAT % (I)	FAT POUNDS (I)	COND. AFF. (J)	INCOME OVER FEED COST $ (K)	PERSISTENCY % (L)	305 2X ME: MILK (A)	305 2X ME: FAT (A)	DIFFERENCE FROM HERDMATES: MILK (B)	DIFFERENCE FROM HERDMATES: FAT (B)	DUE DATE (C)	ACTION NEEDED OR SERVICE SIRE (D)
53	48WHU5832	H	50.5	2.7	1.4	3.49	23	17	1	AGNES (B)	5	57	3-30	5-09	154	10860	2.6	305		890	99%	15750	460	+1420	-40	5-07	P 9-12
113	48WHZ0012	H	36.5	4.1	1.5	2.93	23	19	1	AMY	2	27	7-15	2-09	47	2060	3.1	79		160		11220	445	-2349	-12	6-02	P 10-08
52	48WHU1851	H	40.3	3.0	1.2	2.61	23	13	1	BONNIE	7	52	3-25	4-09	159	8130	3.6	293		624	99%	12340	443	-2581	-60	3*24	
100	48WHX5326	H	17.8	4.2	.7	.43	23	13	1	CARMEN	2	33	9-06	3-00	360	10600	3.8	646		643		18290	671	+2848	+204	12*15	D 10-16
120	48WHZ6051	H	51.0	3.5	1.8	3.65	23	21	1	DAFFY	1		11-23	1-11	282	17100	3.5	599		1410	101%	22710	782	+7544	+230	12*14	D 10-15
101	48WHX5329	H	22.0	4.0	.9	.95	23	11	1	HILDA	2	39	8-05	2-11	392	11226	3.5	391		561		11600	399	-3112	-156	11*20	D 9-21
122	48WHZ6053	H	36.0	3.5	1.3	2.56	23	17	1	H-73	1		11-29	1-11	276	10950	3.4	370		854	101%	14800	494	-904	-70	12*06	D 10-07
106	48WHY2210	H	43.5	3.2	1.4	3.02	23	19	1	JODY	2	52	4-17	3-00	136	6440	3.4	216		523	98%	13020	454	-2165	-44	3*08	
103	48WHX5327	H	61.8	3.9	2.4	4.04	23	26	1	LOLALEE	3	34	7-20	3-10	42	2360	3.6	85		176							B 9-03
57	48WHV3103	H	40.5	3.3	1.3	2.60	23	15	1	MILLY	4	58	10-11	4-08	325	16530	3.6	602		1400		16180	579	+751	+12	11*18	D 9-19
65	48WHW5026	H	40.0	3.4	ST.	2.25	23	16	1	NETTIE	3	53	11-02	3-09	303	16610	3.7	615	S	1240	103%	17520	636	+1992	+71	12*16	D 10-17
99	48WHX1470	H	57.5	3.7	2.1	4.29	23	25	1	ROSIE	3	35	7-21	4-01	41	1860	3.5	65		141						5-26	P 10-01
59	48WHW1291	H	45.8	3.6	1.6	2.96	23	20	1	SYLVIA	3	59	12-14	5-08	261	17190	3.5	602		1313	101%	18470	640	+3140	+85	11*24	D 9-25
63	48WHU5835	H	52.0	3.4	1.8	3.40	23	20	1	TRIXIE	5	107	5-11	6-01	112	7630	3.3	252		458	99%	14570	520	+987	+49	5-28	P 10-03
62	48WHW1294	H	49.0	3.4	1.7	3.13	23	20	1	UNA	4	24	7-10	6-03	52	2550	3.8	97		192		12110	471	-1478	-10		B
105	48WHX5445	H				+1.33	23		1	VIOLET	3	45	8-28	3-10						-31		BODY WEIGHT = 1250					B 10-12
28	48WHSA765	H	28.5	3.4	1.0	1.49	23	7	1	ZELDA	6	60	11-09	10-02	296	15150	3.2	491		1177	101%	15840	509	+305	-51	12*22	D 10-23
29	48WHSA767	H	26.3	4.2	1.1	.96	23	11	1	116	7	54	1-02	9-02	242	9410	4.0	416	N	637	99%	11510	466	-4249	-81	12*22	D 10-23
32	48WHSA769	H	38.0	3.7	1.4	2.21	23	14	1	165	7	46	12-01	9-02	274	15010	3.6	540		1067	102%	16170	577	+761	+21	1*10	
33	48WHSA772	H	53.0	3.6	1.9	3.74	23	19	1	183	7	76	7-03	9-07	59	2590	3.6	93		137		12940	497	-731	-11		B
127	48WHW5057	H	56.5	3.4	1.9	3.65	23	22	1	190	1		6-11	2-05	81	4290	3.5	150		316	106%	17200	598	+3829	+120	4-19	P
130	48WHW5053	H	47.5	3.7	1.8	3.23	23	19	1	192	1		6-13	2-05	79	3280	3.4	112		253	106%	14420	540	+820	+83	4-29	P 9-04
126	48WHW5056	H	50.5	3.2	1.6	3.46	23	21	1	194	1		5-24	2-04	99	5010	3.2	160		370	103%	15290	513	+1640	+44		B
125	48WHZ6078	H	30.8	3.7	1.1	1.50	23	15	1	195	1		12-01	2-00	274	10770	3.8	409		708	100%	14240	530	-1179	-25	1*04	
19	48WHS8775	H	44.0	3.6	1.6	3.05	23	14	1	303	8	56	7-02	9-10	60	3240	3.8	122		296		12160	483	-1433	+10	5-10	P 9-15
116	48WHZ6003	H	44.0	2.8	1.2	2.70	23	17	1	404	1		10-13	2-00	323	15840	2.9	467		1174		18760	544	+3508	+7	4-10	P
24	48WHS8659	H	42.3	3.3	1.4	2.45	23	14	1	537	7	22	7-06	9-04	54	2370	3.3	78		164		11470	433	-2216	-28		B
39	48WHS8584	H	27.0	3.8	1.0	1.32	23	10	1	792	6	42	4-23	8-02	496	20930	3.6	753		1362		15570	566	+346	+4	2*10	
108	48VPES779	H	29.8	3.8	1.1	1.32	23	12	1	833	2	46	12-25	3-01	250	11200	3.8	426		789	99%	13730	512	-1770	-44	12*19	D 10-20
110	48VPER272	H	41.5	3.5	1.5	2.44	23	17	1	12A	2	50	2-11	3-01	202	13400	3.7	496		1052	99%	17810	665	+2818	+142	1*06	

STRING	(A) % IN COWS	% IN MILK	(VI)						(B) % PROT NEEDED		(C) B/WT													
1	30	97		38.7	3.6	1.4	2.50	23	16		14	49	1280	5-01	191					101%	15030	534	+316	+17		
65	48WHW1229	H	----	DRY	---	-.68			3	ABBY	3	48	7-28	4-02						-33		15210	532	+832	-1	10*04	F 9-20
61	48WHW1293	H	----	DRY	---	-.62			3	CARLOTA	3	68	8-22	5-04						-42		18520	667	+4084	+124	8*15	F 8-01
22	48WHS8794	H	----	DRY	---	-.73			3	SUSAN	8	25	9-10	10-08						-18		17990	611	+3061	+59	11*15	
96	48WHU1851	H	----	DRY	---	-.61			3	184	4	76	7-19	5-04						-52		13180	453	-1313	-78		B
115	48WHZ6002	H	----	DRY	---	-.62			3	199	1	18	10-08	2-00						-11		17450	591	+2123	+32	9*30	F 9-16

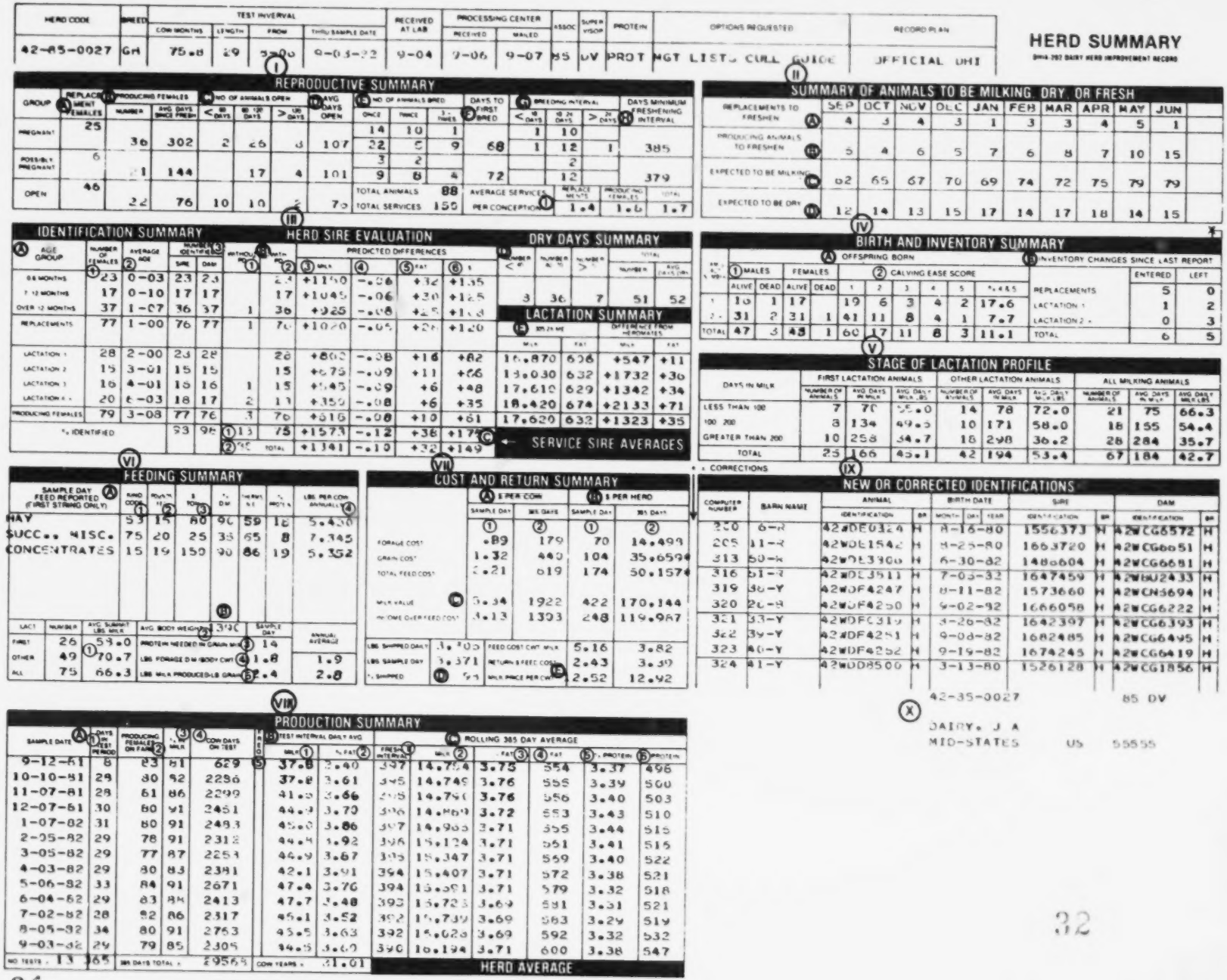
STRING	(A) % IN COWS	% IN MILK							(B) % PROT NEEDED		(C) B/WT													
3	9	0		0	0	0	-.65					60	1310	4-11								15190	547	+319	+11		

HERD AVG.	(A) 63	84		32.6	3.6	1.2	1.88	20	14		(B) 13		57	(C) 1300	5-03	232					101%	15060	463	+276	+8		
	53 IN MILK			38.8	3.6	1.4																				
			(VII)																							
			STATUS-DATE												• • •	L A C T A T I O N S	• • •									
101	48WHX5329	H		IN MILK					1	HILDA	2	39	8-05	2-11	365	10700	3.5	372		564		11600	399	-3112	-82		
57	48WHV3103	H		IN MILK					1	MILLY	4	58	10-11	4-08	305	15710	3.7	579		1348		16180	579	+751	+86		
22	48WHS8794	H		DRY	8-06				3	SUSAN	8	42	9-10	10-08	331	16570	3.3	544		1231		17990	586	+3061	+100		
116	48WHZ6003	H		IN MILK					1	404	1		10-13	2-00	305	15010	3.0	446		1123		18760	544	+3508	+47		
115	48WHZ6002	H		IN MILK					3	199	1		10-08	2-00	305	13960	3.5	484		1111		17450	591	+2123	+98		
115	48WHZ6002	H		DRY	8-13				3	199	1		10-08	2-00	310	14130	3.5	489		1122		17450	591	+2123	+98		
118	48WHZ6005	H		DRY	9-13				3	201	1		10-27	2-00	291	10620	3.9	419		859		13280	511	-2345	+12		

NOTE - 24 MILKING COWS IN STRING TWO AND 4 DRY COWS NOT LISTED TO PROVIDE SAMPLE HERD OF ONE PAGE.

MID-STATES DAIRY RECORD PROCESSING CENTER, STATE COOPERATIVE EXTENSION SERVICES AND DAIRY IMPROVEMENT PROGRAMS LABORATORY, USDA, COOPERATING

Credit: "How to Interpret the Sample Day and Lactation Report (DHIA-200)" Guide to Using DHI Reports. Ames, Iowa: Mid-States Dairy Records Processing Center, p. 1.



HERD SUMMARY
DHIA-202 DAIRY HERD IMPROVEMENT RECORD

HERD CODE	BREED	TEST INVERVAL: COW MONTHS	TEST INVERVAL: LENGTH	TEST INVERVAL: FROM	TEST INVERVAL: THRU SAMPLE DATE	RECEIVED AT LAB	PROCESSING CENTER: RECEIVED	PROCESSING CENTER: MAILED	ASSOC	SUPER VISOR	PROTEIN	OPTIONS REQUESTED	RECORD PLAN
42-85-0027	GH	75.8	29	8-05	9-03-82	9-04	9-06	9-07	85	DV	PROT	MGT LIST, CULL GUIDE	OFFICIAL DHI

(I) REPRODUCTIVE SUMMARY

GROUP	(A) REPLACEMENT FEMALES	(B) PRODUCING FEMALES: NUMBER	(B) PRODUCING FEMALES: AVG DAYS SINCE FRESH	(C) NO OF ANIMALS OPEN: < 60 DAYS	(C) 60-120 DAYS	(C) > 120 DAYS	(D) AVG DAYS OPEN	(E) NO OF ANIMALS BRED: ONCE	TWICE	3+ TIMES	(F) DAYS TO FIRST BRED	(G) BREEDING INTERVAL: < 18 DAYS	18-24 DAYS	> 24 DAYS	(H) DAYS MINIMUM FRESHENING INTERVAL
PREGNANT	25	36	302	2	26	8	107	14	10	1		1	10		
								22	5	9	68	1	12	1	385
POSSIBLY PREGNANT	6	1	144		17	4	101	3	2				2		
								9	8	4	72		12		379
OPEN	46	22	76	10	10	2	79	TOTAL ANIMALS 88			AVERAGE SERVICES PER CONCEPTION (I) 1.4				
								TOTAL SERVICES 150				REPLACEMENTS 1.6	PRODUCING FEMALES 1.6		TOTAL 1.7

(II) SUMMARY OF ANIMALS TO BE MILKING, DRY, OR FRESH

	SEP	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN
(A) REPLACEMENTS TO FRESHEN	4	3	4	3	1	3	3	4	5	1
(B) PRODUCING ANIMALS TO FRESHEN	5	4	6	5	7	6	8	7	10	15
(C) EXPECTED TO BE MILKING	62	65	67	70	69	74	72	75	79	79
(D) EXPECTED TO BE DRY	12	14	13	15	17	14	17	18	14	15

(III) IDENTIFICATION SUMMARY

(A) AGE GROUP	(1) NUMBER OF FEMALES	(2) AVERAGE AGE	(3) NUMBER IDENTIFIED: SIRE	DAM
0-6 MONTHS	23	0-03	23	23
7-12 MONTHS	17	0-10	17	17
OVER 12 MONTHS	37	1-07	36	37
REPLACEMENTS	77	1-00	76	77
LACTATION 1	28	2-00	23	28
LACTATION 2	15	3-01	15	15
LACTATION 3	16	4-01	15	16
LACTATION 4 +	20	6-03	18	17
PRODUCING FEMALES	79	3-08	77	76
% IDENTIFIED			93	96

HERD SIRE EVALUATION

	(1) WITHOUT PROGENY	(2) WITH PROGENY	PREDICTED DIFFERENCES (3) MILK	(4)	(5) FAT	(6) $
0-6 MONTHS		23	+1150	-.06	+32	+135
7-12 MONTHS		17	+1045	-.06	+30	+128
OVER 12 MONTHS	1	36	+925	-.08	+25	+108
REPLACEMENTS	1	76	+1020	-.05	+28	+120
LACTATION 1		28	+800	-.08	+16	+82
LACTATION 2		15	+675	-.09	+11	+66
LACTATION 3	1	15	+945	-.09	+6	+48
LACTATION 4 +	2	11	+350	-.08	+6	+35
PRODUCING FEMALES	3	76	+516	-.08	+10	+61
(1) 13 (2) 90 TOTAL		75	+1573	-.12	+36	+175 (C)
			+1341	-.10	+32	+149 ← SERVICE SIRE AVERAGES

DRY DAYS SUMMARY

(A) AGE GROUP	(1) NUMBER < 40	(2) NUMBER 40-70	(3) NUMBER > 70	TOTAL NUMBER	TOTAL AVG DAYS DRY
0-6 MONTHS					
7-12 MONTHS	3	36	7	51	52
OVER 12 MONTHS					
REPLACEMENTS					
LACTATION 1					
LACTATION 2					
LACTATION 3					
LACTATION 4 +					
PRODUCING FEMALES					

LACTATION SUMMARY

	(A) NUMBER	(B) AVG 305 2X ME MILK	(B) AVG 305 2X ME FAT	DIFFERENCE FROM HERDMATES MILK	DIFFERENCE FROM HERDMATES FAT
FIRST	26	16,870	606	+547	+11
OTHER	49	19,030	632	+1732	+36
ALL	75	17,610	629	+1342	+34

(IV) BIRTH AND INVENTORY SUMMARY

(A) OFFSPRING BORN: (1) MALES ALIVE	MALES DEAD	FEMALES ALIVE	FEMALES DEAD	(2) CALVING EASE SCORE 1	2	3	4	5	%-4&5
1	10	1	17		19	6	3	4	2	17.6
2+	31	2	31	1	41	11	8	4	1	7.7
TOTAL	47	3	48	1	60	17	11	8	3	11.1

(B) INVENTORY CHANGES SINCE LAST REPORT

	ENTERED	LEFT
REPLACEMENTS	5	0
LACTATION 1	1	2
LACTATION 2 +	0	3
TOTAL	6	5

(V) STAGE OF LACTATION PROFILE

DAYS IN MILK	FIRST LACTATION ANIMALS: NUMBER OF ANIMALS	AVG DAYS IN MILK	AVG DAILY MILK LBS	OTHER LACTATION ANIMALS: NUMBER OF ANIMALS	AVG DAYS IN MILK	AVG DAILY MILK LBS	ALL MILKING ANIMALS: NUMBER OF ANIMALS	AVG DAYS IN MILK	AVG DAILY MILK LBS
LESS THAN 100	7	70	55.0	14	78	72.0	21	75	66.3
100-200	8	134	49.3	10	171	58.0	18	155	54.4
GREATER THAN 200	10	258	34.7	18	298	36.2	28	284	35.7
TOTAL	25	166	45.1	42	194	53.4	67	184	42.7

* = CORRECTIONS

(VI) FEEDING SUMMARY

SAMPLE DAY FEED REPORTED (FIRST STRING ONLY) (A)	KIND CODE (1)	% IN RATION (2)	$ TONNAGE (3)	% DM	HAY EQ	% PROT	LBS PER COW ANNUALLY (4)
HAY	53	15	80	90	59	12	5,430
SUCC.. MISC.	75	20	25	35	65	8	7,345
CONCENTRATES	15	19	150	90	86	19	5,352

(B)

LACT	NUMBER	AVG SUMMIT LBS MILK (1)	AVG BODY WEIGHT (2)	SAMPLE DAY	ANNUAL AVERAGE
FIRST	26	59.0	PROTEIN NEEDED IN GRAIN MIX (3)	14	
OTHER	49	70.7	LBS FORAGE D.M./BODY CWT (4)	1.8	1.9
ALL	75	66.3	LBS MILK PRODUCED/LB GRAIN (5)	2.4	2.8

(VII) COST AND RETURN SUMMARY

	(A) $ PER COW: SAMPLE DAY (1)	365 DAYS (2)	$ PER HERD: SAMPLE DAY (1)	365 DAYS (2)
FORAGE COST	.89	179	70	14,499
GRAIN COST	1.32	440	104	35,659
TOTAL FEED COST	2.21	619	174	50,157
MILK VALUE (B)	5.34	1922	422	170,144
INCOME OVER FEED COST	3.13	1303	248	119,987
LBS SHIPPED DAILY	36.00	FEED COST CWT MILK	5.16	3.82
LBS SAMPLE DAY	36.71	RETURN $ FEED COST	2.43	3.39
% SHIPPED (D)	99	MILK PRICE PER CWT (E)	12.52	12.92

(VIII) PRODUCTION SUMMARY

SAMPLE DATE (A)	(1) DAYS IN TEST PERIOD	(2) PRODUCING FEMALES ON FARM	(3) % IN MILK	(4) COW DAYS ON TEST	(5) TEST INTERVAL DAILY AVG: MILK (1)	% FAT (2)	(6) ROLLING 365 DAY AVERAGE: FINAL INTERVAL (1)	MILK (2)	% FAT (3)	4% FAT (4)	% PROTEIN (5)	PROTEIN (6)
9-12-81	8	83	81	629	37.8	3.40	397	14,764	3.75	554	3.37	498
10-10-81	29	80	92	2296	37.8	3.61	395	14,749	3.76	555	3.39	500
11-07-81	28	81	86	2299	41.3	3.66	395	14,756	3.76	556	3.40	503
12-07-81	30	80	91	2451	44.3	3.70	396	14,869	3.72	553	3.43	510
1-07-82	31	80	91	2483	45.3	3.86	397	14,965	3.71	555	3.44	515
2-05-82	29	78	91	2312	44.5	3.92	396	15,124	3.71	561	3.41	515
3-05-82	29	77	87	2253	44.9	3.87	395	15,147	3.71	559	3.40	522
4-03-82	29	80	83	2381	42.1	3.91	394	15,407	3.71	572	3.38	521
5-06-82	33	84	91	2671	47.4	3.76	394	15,591	3.71	579	3.32	518
6-04-82	29	83	88	2413	47.7	3.48	393	15,723	3.69	581	3.31	521
7-02-82	28	82	86	2317	45.1	3.52	392	15,739	3.69	583	3.29	519
8-05-82	34	80	91	2763	45.5	3.63	392	15,828	3.69	592	3.32	532
9-03-82	29	79	85	2305	44.5	3.60	390	16,194	3.71	600	3.38	547
NO. TESTS 13	365	365 DAYS TOTAL =		29564	COW YEARS =		81.01	HERD AVERAGE				

(IX) NEW OR CORRECTED IDENTIFICATIONS

COMPUTER NUMBER	BARN NAME	ANIMAL IDENTIFICATION	BR	BIRTH DATE MONTH	DAY	YEAR	SIRE IDENTIFICATION	BR	DAM IDENTIFICATION	BR
220	6-R	42WDE0324	H	8-16-80			1556373	H	42WCG6572	H
205	11-R	42WDE1542	H	8-25-80			1663720	H	42WCG6051	H
313	50-R	42WDE3900	H	6-30-82			1664604	H	42WCG6681	H
316	51-R	42WDE3911	H	7-03-82			1647459	H	42WBU2433	H
319	36-Y	42WDF4247	H	8-11-82			1573660	H	42WCN5694	H
320	20-R	42WDF4250	H	9-02-82			1666058	H	42WCG6222	H
321	33-Y	42WDFC319	H	8-26-82			1642397	H	42WCG6393	H
322	34-Y	42WDF4251	H	9-08-82			1682485	H	42WCG6495	H
323	40-Y	42WDF4252	H	9-19-82			1674245	H	42WCG6419	H
324	41-Y	42WDD8500	H	3-13-80			1526128	H	42WCG1856	H

(X) 42-85-0027 85 DV
DAIRY, J A
MID-STATES US 55555

31

32

Credit: "How to Interpret the Herd Summary (DHIA-202)." Guide to Using DHI Records. Ames, Iowa: Mid-States Dairy Records Processing Center, p. 1.

21

Marketing Options

Producer cooperatives play a vital role in milk marketing today. Cooperatives such as Mid-America Dairymen and Associated Milk Producers handle about 75% of all milk sold. Private firms, such as Kraft, and direct-to-consumer sales combine to handle the remaining 25% of marketed milk.

Component Pricing

This form of pricing takes into consideration the worth of solids-not-fat variations, as well as fat. Milkfat and protein are the two major variables in milk, which vary considerably among breeds and herds and are somewhat dependent on the season. Lactose and minerals remain fairly constant at about 5% and .7%.

There are major issues associated with component pricing. The value of solids-not-fat has gone up dramatically since 1965; however, producers are frequently paid only on a fat basis. Without component pricing, farmers with a high protein level relative to fat do not get paid for the extra protein. Protein can vary as much as 2.8%-3.4% for milk from two different herds that both test 3.5% butterfat. Additional protein in milk results in added income due to higher yields of skim milk powder, cheese and other protein-rich dairy products. Consumers are more protein-conscious, and milk and dairy products can provide consumers with relatively low-cost protein.

Premiums for Quality Milk

Producers benefit directly and indirectly from the production of quality milk with a low somatic cell count. A direct benefit is that cheese yield increases as somatic cell counts decrease. An indirect benefit is that by keeping the somatic cell counts low, milk production generally increases without additional cost.

Research conducted at university and federal facilities has shown that milk with a low somatic cell count is produced by cows with healthy udders. It also shows cows with low somatic cell counts produce more milk with higher butterfat content.

Many companies pay premiums to producers based on standards in the following areas: somatic cell count; standard plate count (bacteria); and antibiotic, water and sediment content. Table 7.1 gives standards at the Wisconsin Dairies Cooperative.

TABLE 7.1 - Quality payment standards

Test	Base price	6¢ premium	12¢ prem.
Standard plate count	> 25,000	< 25,000	< 25,000
Somatic cell count	>501,000	301,000-500,000	<300,000
Antibiotics	negative	negative	negative
Cryoscope (added water)	none	none	none

Non-Traditional Dairy Products

Researchers such as those at Dairy Research Inc. (DRINC) in Illinois, an arm of the United Dairy Industry Association, are working on new, non-traditional dairy products designed to appeal to a larger dairy market. These products include spreadable butter, carbonated milk, high-calcium milk and ultra high-temperature processed milk.

Spreadable butter - Market analysis has indicated a need for an all-dairy butter spread with reduced calories, fat and cholesterol. Spreadable butter fills those needs with 35-40% less fat, cholesterol and calories than traditional butter or margarine. DRINC researchers have also experimented with flavored butters such as herb, garlic and chive.

Carbonated milk - Americans consume quantities of carbonated beverages yearly, as indicated by the recent tremendous growth in the soft drink industry. Carbonated milk could give the dairy industry an opportunity to enter the casual snack market and the restaurant/fast-food industry, where soft drinks predominate.

Statistics indicate Americans spend 43% of their total food dollars on meals out of the home. Researchers estimate that a 6-8% share of the soft drink market could eliminate the U.S. milk surplus, which totaled 13 billion pounds of milk in 1985.

Carbonated milk contains the same nutritional benefits and calories as skim milk, since it is made by combining skim milk and carbonation. Flavorings, such as strawberry, peach, orange, banana, piña colada, chocolate, root beer and cola are being tested, as well as sweeteners. Total calorie content varies, depending on the flavoring and sweetener added.

High-calcium milk - More and more consumers are concerned about getting enough calcium in their daily diet. Other high-calcium milks on the market often add calcium from chemicals and sources other than milk, which may settle at the bottom of the glass or give a chalky aftertaste. DRINC's high-calcium milk is made up of completely dairy-derived, natural products.

An 8-ounce serving of DRINC's high-calcium milk satisfies 65-70% of the adult recommended allowance of 1,000 milligrams of calcium. The high-calcium drink has the same nutrient value and calories as the base milk used in its production. Phosphorus is added because of its role in the body's absorption of calcium.

Ultra high-temperature processed milk - Although common in Europe for the past 15-20 years, this product is relatively new in the U.S. Ultra high-temperature milk has been pasteurized at 300F for 6-9 seconds, as opposed to normal pasteurization at 170F for 20 seconds. No refrigeration is required for this milk since it is sterile after processing. The product has a shelf-life of six months, as opposed to 2-3 weeks of refrigerated life for regular whole milk. The high production and packaging costs, plus consumer demand for cold milk, has prohibited the widespread use of this product in the U.S.

Credits

Bath, Donald L., et. al. Dairy Cattle: Principles, Practices, Problems, Profits, 2nd ed. Philadelphia: Lea & Febiger, 1978, pg. 37.

Campbell, John R.; Robert T. Marshall. The Science of Providing Milk for Man. New York: McGraw-Hill, 1975.

Gillespie, James R. Modern Livestock and Poultry Production, 2nd ed. Albany, New York: Delmar, 1983, pg. 694.

Dairy Research Inc. news releases. Rosemont, Ill.: United Dairy Industry Association, 1986.

"Rise and Shine With Us." Baraboo, Wisc.: Wisconsin Dairies Cooperative, 1984.

Markets for Replacements

Several markets are available for replacements, but a producer must first decide on the type of buyer or type of stock desired. Public auctions held at local auction barns have special weekly or monthly dairy sales at which breeding stock is marketed. Private auctions are held on the farm when a producer has enough livestock to attract buyers. Breed association sales are frequently used by producers of registered breeding stock with limited numbers to market. In a private treaty, producers can use newspapers, breed journals or word-of-mouth for advertisement, setting their own prices and guarantees.

Recordkeeping for Dairy Replacements

Producers should maintain DHIR or DHI records on the herd. Individual animals are classified by the official classifying personnel of the breed association. Recorded pedigrees should be kept for all registered breeding stock in the herd. For grade animals, pedigree information should be kept up-to-date, as well. Test the herd regularly for tuberculosis, leptospirosis and brucellosis. To aid in identifying animals, use neck chains, numbered ear tags, brands, leg bands or a photographic file.

Registered vs. Grade

It should be noted that any animal not having registration papers is considered grade, even though it may be a purebred.

Registered stock advantages such as known ancestry--and thus selection--can be based in part on the known production records of past generations. Marketing options are expanded because local, state and national breed association sales are limited to registered stock only. The production of breeding stock can generate income through sales of registered bulls for use in commercial herds and of heifers to 4-H and FFA members.

Disadvantages of registered stock include higher production costs because of registration fees and purchase prices, as well as an increased time requirement for promotions and recordkeeping.

The main advantage of using grade stock is the reduced investment resulting from greater availability and quantity. Disadvantages of grade stock usually include lower-producing breeding stock since the offspring of crossbred cows usually don't perform at the same production level as their parents. The reduced value of breeding stock, while advantageous when purchasing, is a disadvantage when selling. Also, unknown ancestry translates into unknown genetic potential.

Advertising and Promotion

Road signs can be used to advertise breeds produced and breeding stock for sale. These signs are a cheap yet effective way to reach local producers. Newspapers and breed journals allow producers to advertise animals or groups

of animals to be sold. While this type of advertising is more expensive, many more people are reached nationwide. The exhibition of select stock at county, state and national shows and fairs can be an excellent promotion for quality stock. Furthermore, personal contact can be made with farmers interested in purchasing stock.

Producer-sponsored field days or judging contests benefit local 4-H and FFA groups through instruction. Students become aware of producers' stock and may be encouraged to come back later as producers to select breeding stock.

Credits

Bundy, Diggins and Christensen. Dairy Production. 4th ed. Englewood Cliffs, N.J.: Prentice-Hall, Inc., 1979, pg. 292-293.

Animal Health Regulations

All milk for pasteurization shall be from herds in Modified Accredited Tuberculosis Areas (as determined by the USDA), shall be accredited tuberculosis-free or have passed an annual tuberculosis test. Milk for pasteurization shall be from herds under a brucellosis eradication program which meets one of the following conditions.

1. Located in a Certified Brucellosis-Free Area (as defined by the USDA) and enrolled in the testing program
2. Located in a Modified Certified Brucellosis Area and enrolled in the testing program
3. Meet USDA requirements for an individually certified herd
4. Participate in a milk ring testing program with individual blood tests done on all animals showing suspicious reactions to the milk ring test
5. Have an individual blood agglutination test done annually

For diseases other than brucellosis and tuberculosis, the regulatory agency requires physical, chemical or bacteriological tests as it deems necessary.

Farm Inspection

State inspection regulations require that each dairy farm be inspected by the regulatory agency prior to the issuance of a permit. Following the permit's issuance, farms shall be inspected at least once every six months. Should a violation occur, a second inspection shall be conducted to determine compliance with requirements. Non-compliance of requirements can result in loss of the permit to produce and sell Grade A milk.

Milk production areas to be inspected include cows; milking barn, stable or parlor; milkhouse or room; toilet and water supply; utensils and equipment; milking procedures; personnel; milk cooling; vehicles; and insect and rodent control. See the sample inspection form which follows this lesson's discussion.

Processing Plant Tests

As spoilage in milk occurs, lactic acid is formed. The acidity test measures the amount of lactic acid in milk. Standard plate counts are used to determine the number of somatic cells present in milk. Butterfat tests verify the percent of butterfat in milk against the percent paid to the producer. Percent butterfat must be known when producing certain products, such as whole milk or cheese. A cryoscope measures the water content of milk. Antibiotic tests are conducted on each tank of milk to make sure no antibiotics are present. The phosphatase test is performed on pasteurized milk to determine if improper pasteurization has occurred.

Waste Management Regulations

State regulations, following the federal Pasteurized Milk Ordinance (PMO), provide sanitation requirements for dairy farms under the same section which lists health requirements for fluid milk. Actual regulations include the following.

1. The cow yard shall be graded and drained with no standing pools of water or accumulations of organic waste.
2. Cow droppings and soiled bedding shall be removed from lot loafing areas to prevent soiling of cow's udder and flanks.
3. Wasted feed shall not be allowed to accumulate.
4. Manure will be stored inaccessible to cows.

Credits

Quinn, Thomas. Dairy Farm Management. Albany: Delmar, 1980, pg. 300.

"Grade A Pasteurized Milk Regulations." Jefferson City, Mo.: State Milk Board, Missouri Department of Agriculture, 1980.

MISSOURI STATE MILK BOARD

DAIRY FARM INSPECTION REPORT

INSPECTING AGENCY

NAME

POUNDS SOLD DAILY

LOCATION

PLANT

BACTERIA COUNT

PERMIT NO

1 2 3 4 5 6 7 8 9 10 11

SIR: INSPECTION OF YOUR FARM TODAY SHOWED VIOLATIONS EXISTING IN THE ITEMS CHECKED BELOW. YOU ARE FURTHER NOTIFIED THAT THIS INSPECTION SHEET SERVES AS NOTIFICATION OF THE INTENT TO SUSPEND YOUR PERMIT IF THE VIOLATIONS NOTED ARE NOT IN COMPLIANCE AT THE TIME OF THE NEXT INSPECTION (SEE SECTIONS 7 AND 8 OF THE GRADE A PASTEURIZED MILK ORDINANCE - 1978 RECOMMENDATIONS OF THE U.S. PUBLIC HEALTH SERVICE FOOD AND DRUG ADMINISTRATION)

COWS

1. Abnormal Milk ☐ 12
   - Cows secreting abnormal milk milked last or in separate equipment (a)
   - Abnormal milk properly handled and disposed of (b)
   - Proper care of abnormal milk handling equipment (c)

MILKING BARN, STABLE, OR PARLOR

2. Construction ☐ 13
   - Floors, gutters, and feed troughs of concrete or equally impervious materials, in good repair (a)
   - Walls and ceilings smooth, painted or finished adequately; in good repair; ceiling dust-tight (b)
   - Separate stalls or pens for horses, calves, and bulls (c)
   - Adequate natural and/or artificial light; well distributed (d)
   - Proper feed storage facilities (e)
   - Properly ventilated; no overcrowding (f)
3. Cleanliness ☐ 14
   - Clean and free of litter (a)
   - No swine or fowl (b)
4. Cowyard ☐ 15
   - Graded to drain; no pooled water or wastes (a)
   - Cowyard clean; cattle housing areas properly maintained (b)
   - No swine (c)
   - Manure stored inaccessible to cows (d)

MILKHOUSE OR ROOM

5. Construction and Facilities ☐ 16

Floors
- Smooth; concrete or other impervious material in good repair (a)
- Graded to drain (b)
- Drains trapped, if connected to sanitary system (c)

Walls and Ceilings ☐ 17
- Approved material and finish (a)
- Good repair (windows, doors and hose port included) (b)

Lighting and Ventilation ☐ 18
- Adequate natural and/or artificial light; properly distributed (a)
- Adequate ventilation (b)
- Doors and windows closed during dusty weather (c)
- Vents and lighting fixtures properly installed (d)

Miscellaneous Requirements ☐ 19
- Used for milkhouse operations only; sufficient size (a)
- No direct opening into living quarters or barn, except as permitted by Ordinance (b)
- Liquid wastes properly disposed of (c)
- Proper hoseport where required (d)
- Acceptable surface under hoseport (e)
- Suitable shelter for transport truck as required by this Ordinance (f)

MILKHOUSE OR ROOM - Continued

Cleaning Facilities ☐ 20
- Two compartment wash and rinse vat of adequate size (a)
- Suitable water heating facilities (b)
- Water under pressure piped to milkhouse (c)

6. Cleanliness ☐ 21
   - Floors, walls, windows, tables, and similar non-product contact surfaces clean (a)
   - No trash, unnecessary articles, animals or fowl (b)

TOILET AND WATER SUPPLY

7. Toilet ☐ 22
   - Provided; conveniently located (a)
   - Constructed and operated according to Ordinance (b)
   - No evidence of human wastes about premises (c)
   - Toilet room in compliance with Ordinance (d)
8. Water Supply ☐ 23
   - Constructed and operated according to Ordinance (a)
   - Complies with bacteriological standards (b)
   - No connection between safe and unsafe supplies; no improper submerged inlets (c)

UTENSILS AND EQUIPMENT

9. Construction ☐ 24
   - Smooth, impervious, nonabsorbent, safe materials; easily cleanable, seamless hooded pails (a)
   - In good repair; accessible for inspection (b)
   - Approved single-service articles, not reused (c)
   - Utensils and equipment of proper design (d)
   - Approved CIP milk pipeline system (e)
10. Cleaning ☐ 25
    - Utensils and equipment clean (a)
11. Sanitization ☐ 26
    - All multi-use containers and equipment subjected to approved sanitization process (see Ordinance) (a)
12. Storage ☐ 27
    - All multi-use containers and equipment properly stored (a)
    - Stored to assure complete drainage, where applicable (b)
    - Single-service articles properly stored (c)
13. Handling ☐ 28
    - Sanitized milk contact surfaces not exposed to contamination (a)

MILKING

14. Flanks, Udders, and Teats ☐ 29
    - Milking done in barn, stable, or parlor (a)
    - Brushing completed before milking begun (b)
    - Flanks, bellies, udders, and tails of cows clean at time of milking; clipped when required (c)
    - Udders and teats treated with sanitizing solution and dried, just prior to milking (d)
    - No wet hand milking (e)

MILKING - Continued

15. Surcingles, Milk Stools and Anti-Kickers ☐ 30
    - Clean; stored above floor in clean place (a)
    - Stools, easily cleanable construction and not padded (b)

TRANSFER AND PROTECTING OF MILK

16. Protection from Contamination ☐ 31
    - No overcrowding (a)
    - Overflowed, leaked, spilled, or improperly handled milk discarded (b)
    - Immediate removal of milk to milkhouse (c)
    - Transfer, pouring, and/or straining facilities properly protected (d)
    - Air under pressure of proper quality (e)
    - Antibiotics and medicinals properly stored (f)
    - Product and CIP circuits separated (g)

PERSONNEL

17. Hand-washing Facilities ☐ 32
    - Proper hand washing facilities in milk room and convenient to milking operations (a)
    - Wash and rinse vats not used as hand-washing facilities (b)
18. Personnel Cleanliness ☐ 33
    - Hands washed clean and dried before milking, or performing milkhouse functions; rewashed when contaminated (a)
    - Clean outer garments worn (b)

COOLING

19. Cooling ☐ 34
    - Milk cooled to 45° F. or less within 2 hours after milking except as permitted by Ordinance (a)
    - Recirculated cooling water from safe source and properly protected; complies with bacteriological standards (b)

VEHICLES

20. Vehicles ☐ 35
    - Vehicles clean (a)
    - Constructed so as to protect milk (b)
    - No contaminating substances transported (c)

INSECTS AND RODENTS

21. Insect and Rodent Control ☐ 36
    - Fly breeding minimized by approved manure disposal methods (see Ordinance) (a)
    - Manure packs properly maintained (b)
    - All milkhouse openings effectively screened or otherwise protected; doors tight and self-closing, screen doors open outward (c)
    - Milkhouse free of insects and rodents (d)
    - Approved pesticides, used properly (e)
    - Equipment and utensils not exposed to pesticide contamination (f)
    - Surroundings neat and clean, free of harborages and breeding areas (g)

REMARKS

DATE

SANITARIAN

NOTE: Item numbers correspond to required sanitation items for Grade A raw milk for pasteurization in the Grade A Pasteurized Milk Ordinance 1978 Recommendations of the U.S. Public Health Service/Food and Drug Administration.

MO 350-0025 (9-86) **DISTRIBUTION: ORIGINAL**/PRODUCER; **CANARY**/COOPERATIVE; **PINK**/MILK SANITARIAN SMB 14 REV 8/86

Seasonal Peaks and Demands

Milk production peaks are usually more seasonal than consumption demands. Grade A milk surpluses generally occur in the spring and early summer, while the greatest utilization of Grade A supplies occurs in the fall and winter.

Many milk processors use a fluid milk formula which should encourage producers to freshen cows in the fall and winter. During periods when Class I production exceeds consumption, excess fluid milk is used for manufacturing purposes. Producers are paid based on the milk's usage, even though 100% of the milk may qualify as fluid milk. Prices paid for milk used in manufacturing products are lower than those paid for fluid milk. Fall and winter prices are usually the highest per cwt.

Freshening in the fall and winter results in more total milk production per cow. Producers should select the individual's freshening dates in advance of breed shows and/or sales in which they will participate.

Measuring Somatic Cells

Because mastitis is frequently "hidden," a number of tests have been developed for its detection. Most tests estimate the somatic cell count (SCC) of a milk sample. The term "somatic" simply means "derived from the body." All milk contains leucocytes and a few secretory cells. The count for normal milk is usually less than 200,000 cells/ml (lower for first lactation cows). Higher counts are abnormal.

Leucocytes accumulate at the inflamed site to combat invading bacteria. While excessive SCC usually indicates an infection, other factors may also increase counts. However, factors such as late lactation, old age and environmental stress elevate SCC only slightly compared to infection.

Mastitis Affects on Production

Bulk tank somatic cell counts (BTSCC), if conducted frequently and accurately, provide a general indication of the mastitis status of the herd. Recent research indicates that losses in milk production associated with elevated BTSCC are higher than previously estimated.

TABLE 10.1 - Milk production losses and elevated BTSCC

BTSCC (1000's/ml)	% production loss
200	0
500	6
1,000	18
1,500	29

These losses were calculated as the percentage of expected production at a BTSCC of 200,000 cells/ml. Since 6% of quarters are infected in herds with a BTSCC of 200,000, this is still a conservative estimate of milk loss. Thus, herds with a BTSCC of greater than 500,000 cells/ml have serious losses in milk yield due to subclinical mastitis even though they are well below the regulatory level.

In an effort to provide more uniform reporting of SCC, the Dairy Herd Improvement Association has adopted a uniform scoring method called the linear score (LS). The LS divides the SCC into 10 categories from 0 through 9. Each increase in LS is associated with a doubling in the cell count.

Analysis of records on many cows indicates that as the LS increases, milk yield decreases (see Table 10.2). It cannot, however, be determined from this type of study if the elevated cell count causes the decrease in milk yield. While this seems likely at a LS of five or greater (since the incidence of subclinical infection is high), additional research is needed to determine the extent of losses at lower cell count levels.

TABLE 10.2 - Estimated change in yield associated with increased LS

Lactation average LS	Geometric lactation average SCC	Decrease in milk yield (lbs./305 days) Lact. #1	Lact. #2
3	100	---	---
4	200	400	800
5	400	600	1,200
6	800	800	1,600
7	1,600	1,000	2,000

Credit: Adapted from University of Wisconsin data.

An increase in milk yield would be expected with improvements in herd cell counts, but lowering counts in a few individuals might not result in increased production.

Credits

Campbell, John R.; Robert T. Marshall. The Science of Providing Milk for Man. New York: McGraw-Hill, 1975, pg. 407.

"The Value and Use of Dairy Herd Improvement: Somatic Cell Count." Arlington, Va.: National Mastitis Council, n.d.

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Reproductive Dairy Herd Health Program—Routine Examinations

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Improved selection and feeding have helped dairymen produce more milk. However, in many cases, net income (return) to the dairyman may not have increased with increased milk production due to not getting cows bred on time. To maximize income, cows should calve every 12 to 13 months.

Dairy Reproductive Records

What are the steps in developing a dairy reproductive program to obtain a 12 or 13 month calving interval? The first and most important step is to establish a lifetime record for each cow. These records are the animal's reproductive history. They will be the most valuable aid for the dairyman and veterinarian to predict future occurrences and treatments. UMC Guide No. 3010 "Reproductive Dairy Herd Health Program—Establishing A Record System," illustrates the procedures for developing a simple but thorough dairy reproductive record system.

Routine Veterinary Examinations

The second step in developing a dairy herd reproductive program is to establish routine veterinarian examinations of the reproductive tract of all nonpregnant cows. Establish the examination schedule in advance (for example, the second Tuesday morning or the third Wednesday afternoon of the month) so the dairyman and veterinarian can prepare for each visit. Scheduled examinations should be done monthly as a rule; however, larger herds (greater than 100 cows) may need more frequent visits, and smaller herds (less than 40 cows) may need less frequent visits. The scheduled visits by the veterinarian for reproductive examinations may result in a slightly higher total veterinary cost. However, the return per dollar spent on this program will be one of the largest of the dairy enterprise.

In addition to determining the time and day of the first examination, the dairyman and veterinarian should establish a schedule of fees and costs for his services and treatments. Neighboring dairymen may want to schedule herd examinations for the same day. In so doing, each dairyman may be able to reduce veterinary expense. This cost saving step must have the factors of two relatively close dairies with herd sizes not exceeding a veterinarian's daily work load.

Cows to be examined should be corralled prior to the veterinarian's visit for most efficient use of time. The animals' reproductive lifetime record and the monthly reproductive record for the interval following the last exam should be available for the veterinarian's observation.

The monthly reproductive records will provide the veterinarian with individual animal observations and incidents as determined by the dairyman. This monthly information, in addition to the cow's lifetime reproductive record, serves as a basis for determining extent and kind of treatment.

Animals To Be Examined

What cows should be examined by the veterinarian during the monthly visit? Animals falling in the following seven reproductive situations should be observed.[1]

1. Cows that have had a retained placenta should have special attention. If a cow is still retaining the placenta after three to four days postpartum, the veterinarian should be consulted. Manual removal of the placenta should not be attempted. Cows should be examined one or two times prior to breeding to make sure that the uterus is free of apparent infection and returning to normal size.
2. *Cows fresh 25 to 40 days should be examined prior to breeding to make sure that the reproductive tract is free of gross infection and undergoing involution at a normal rate.* It is much easier to clear up a problem early and it is also less costly to the dairyman. There is a good deal of satisfaction in knowing that a cow is normal and ready to conceive on the first or second service. Furthermore, rectal palpation of the ovaries will indicate abnormal function (i.e., cystic ovaries) and an estimation of the time of next heat.
3. Cows with an abnormal discharge or cloudy discharge during heat should be examined to determine the source of infection and treated as indicated by the examination. A discharge with a strong odor or one that contains pus is always abnormal. It may be coming from either the uterus, cervix, vagina or all three areas. If the infection is not localized, it can spread to surrounding areas making treatment more expensive and prolonged. Similarly, cows having some type of abnormal reproductive event should also be examined. These would be cows following the occurrence of dystocia, abortions, mummified fetuses or even those females returning to heat following pregnancy diagnosis.
4. Cows with abnormal heats and heat cycles should be examined to determine the nature of the hormonal imbalance. Normal estrous cycles are generally 18 to 23 days. Abnormal estrus would be those females exhibiting too frequent heat or prolonged intervals between heats.
5. Cows not showing heat 45 to 60 days after calving should be examined so a normal cycle will be present at breeding time. These cows may not come into heat because their uterus contains several quarts of pus which has the same effect on the corpus luteum as a calf. Cystic ovaries frequently prevent cows from showing signs of heat at this time. Some researchers estimate that nearly 90% of cases of a reported anestrus

[1] *Profitable Reproduction in the High-Producing Herd*, David A. Morrow, D.V.M., Michigan State University.

or failure to show heat, results from the failure of observation of heat or a failure of the cow to show symptoms of heat (see UMC Guide 3012 "Detecting Heat In Dairy Cows"). Whether the cow is cycling normally or not will be resolved by the examination.

6. Cows bred two to three times should be examined to determine the cause of the breeding difficulty.
7. *Cows bred 35 to 60 days should be examined for pregnancy*. Those done prior to this time should be repeated from 60 to 90 days. The reason for the second examination is that one cow in ten to fifteen will have an abortion during the first sixty days after breeding. Having a cow diagnosed pregnant at this time will permit the dairyman peace of mind concerning that cow. If she is not pregnant, it is much better to know it early when there is still time to work with the cow so that she will not have to be sent to slaughter because of an extended calving interval.

Following examination, the dairyman should enter all comments and treatments made by the veterinarian on each animal's lifetime reproductive records.

Remember, in evaluating a dairy reproductive program, the results may not be evident for six months to a year. The successful program will increase income through added milk and calf sales while reducing feed and replacement costs of the milking herd.

Cost Comparisons

The costs incurred by not maintaining a 12 or 13 month calving interval many times are not seen by the herd owner. Financial returns of two 60 cow herds with 16,000 pounds of milk lactation averages provide an example. Herd A had a 15 month calving interval with a conception rate of 2.3 services per conception. Herd B had a 13 month calving interval and 1.3 services per conception.

Added costs or decreased returns of herd A compared to herd B:

Annual Loss in Milk Sales

Herd B - $\frac{\text{10.5 mo's in milk}}{\text{13 mo. calving interval}}$ x 100 = 80.7% cows in milk

16000# milk (lactation average) x 80.7% (% cows in milk) = 12,912# ave. annual milk production per cow

Herd A - $\frac{\text{10.5 mo's in milk}}{\text{15 mo. calving interval}}$ x 100 = 70% cows in milk

16000# milk (lactation average) x 70% (% cows in milk) = 11,200# ave. annual milk production per cow

Difference - 12,912# - 11,200 = 1712# x .125 ($12.50 cwt. for 3.5% B.F. milk) = $219 (additional income/cow for herd B) x 60 (herd size) = $12,840

Annual Loss in Calf Sales

Herd B - $\frac{\text{12 mo's/year}}{\text{13 month calving interval}}$ x 100 = 92.3% of herd calving annually

60 (herd size) x 92.3% (% of cows calving annually) = 55.4 calves/year

Herd A - $\frac{\text{12 mo's/year}}{\text{15 month calving interval}}$ x 100 = 80% of herd calving annually

60 (herd size) x 80% (% of cows calving annually) = 48 calves/year

Difference in annual calf crop values 55.4 - 48 = 7.4 calves diff. x $150 (calf value) = $1,110

Dry Cow Maintenance Feed Costs:

Herd B - 100% - 80.7% (% cows in milk) = 19.3% (% of cows dry at all times)

60 (herd size) x 19.3% (% of cows dry at all times) = 11.8 ave. no. cows dry at all times

Herd A - 100% - 70% (% cows in milk) = 30% (% of cows dry at all times)

60 (herd size) x 30% (% cows dry at all times) = 18 ave. no. of cows dry at all times

Difference - 18 dry cows - 11.8 dry cows = 6.2 more dry cows in herd A than herd B at all times.

6.2 (addt. dry cows in herd A) x .50 cents (daily feed costs/head) x 365 (days in year) = $1132 added feed costs for dry cows in herd A, annually.

Added Replacement Costs:

Herd A - 15% of herd or 9 cows are culled annually for reproductive failure.

Herd B - 5% of herd or 3 cows are culled annually for reproductive failure.

Additional Replacements Needed for Herd B (9 cows - 3 cows) = 6 cows.

Replacement cost ($1,110/head) - salvage value of culled cows, 1300# @ $43 cwt. ($559/head) = $541 difference x 6 head = $3,246.

Added Semen Costs:

1.3 services (herd B) vs. 2.3 services (herd A) per conception = 1 additional service per cow in herd A x 48 (No. of cows calving annually in herd A) x $8 (average cost per service) = $384.

In summary, herd A compared to herd B has the following loss in annual income:

Annual Loss in Milk Sales	$12,840
Annual Loss in Calf Sales	1,110
Increased Dry Cow Feed Costs	1,132
Added Replacement Costs	3,246
Added Semen Costs	384
Total Loss in Annual Income (herd A vs. herd B)	$11,712

or $11,712/60 = $311.97 return per cow annually.

Additional costs, herd A, would occur, but not determined in this example are:

(1) Loss of genetically superior proven cows because of reproductive failure;
(2) Loss of possible genetic advancement because of fewer calves per year; and
(3) Loss of interest on investment on a higher percentage nonproductive cow.

■ Issued in furtherance of Cooperative Extension Work Acts of May 8 and June 30, 1914 in cooperation with the United States Department of Agriculture. Leonard C. Douglas, Acting Director, Cooperative Extension Service, University of Missouri and Lincoln University, Columbia, Missouri 65211. ■ An equal opportunity institution.

The government plays a significant role in the dairy industry. Legislation passed in Washington can have a profound effect on the small, as well as the large, producer. Dairies are also indirectly affected by government programs regarding grain products and the import/export quotas placed on these commodities.

Price Supports

The price support program bolsters the milk price received by farmers through purchases of butter, nonfat dry milk and American cheese. Purchase prices are designed to enable manufacturers to pay farmers the support price during surplus production periods.

The support program's objective is to support the price of milk at a level that will assure an adequate supply of ". . . milk to meet current needs, reflect changes in the cost of production, and assure a level of farm income adequate to maintain productive capacity sufficient to meet anticipated future needs."

In the Agricultural Act of 1949 and subsequent amendments to that act, Congress specified three major guidelines for the price support program. First, it provided for minimum and maximum price support levels for farm milk. These prices have been set using parity price guidelines. Second, the program authorized the Secretary of Agriculture to determine the specific price.

Third, supports were set up through purchases of milk and milk products. Since milk is a bulky, perishable product, the government cannot reasonably buy raw milk. Therefore, it purchases all the butter, nonfat dry milk and cheese offered by processors at announced prices. These products are widely produced and take two-thirds of the milk used in manufactured dairy products. Prices received by individual dairy farmers depend upon many factors other than the support level, including plant location, product manufactured, quantity of milk delivered, local competition and plant operating efficiency.

Prices to farmers for manufacturing-grade milk can move above the support level if supply and demand conditions warrant. This occurred in short-supply years until 1980 and, at times, even during peak seasons. However, prices have generally been below the support level since March 1980. The short-supply season usually occurs in October and November when milk production reaches a seasonal low point and fluid milk product demand is seasonally highest. A flush season normally occurs in May and June when milk production reaches its seasonal peak and fluid milk product sales are declining.

In the price support program, producers benefit from smoothed-out prices and a market for milk at an assured price. In most years, especially since 1979, dairy producers have benefitted more from the higher prices under the program than they would have by relying solely on the commercial market. Price supports undergird all prices received by dairy farmers. Disregarding the impacts of import quotas, studies suggest that the price support program has

been more of a price-stabilizing than a price-enhancing policy, except for isolated periods.

Increased returns to individual farmers from higher support prices depend on the volume of individual farm marketings. Since there is a wide range in dairy farm sizes, there is also a wide difference in overall program benefits to each farm.

Effects of Government Programs

The Food and Agriculture Act of 1977 raised the minimum support level to 80% of parity, but that change had little effect since commercial prices had been in the same range. A more significant change, and one that helped motivate a reversal of the 33-year downward trend in cow numbers, was the updating of the support price every six months for the next four years. Legislation in 1979 extended the dairy provisions of the 1977 act through September 1981. That four-year period of 1977 to 1981 was the golden age when dairymen had the best of all worlds--an attractive, guaranteed price that was also guaranteed to keep pace with inflation.

In 1983 the dairy diversion program was authorized. Under this program, contracts were offered to producers who agreed to reduce their marketings 5-30% in return for a $10 per hundredweight payment. The diversion program was an effort to grapple with the surplus program. It was voluntary from the participant aspect, but mandatory from the assessment for management costs aspect. The program did not make any lasting changes in milk output or noticeable changes in the over-expanded manufacturing-processing sector.

Legislation in 1985 contained a host of dairy provisions. The support price was set at $11.10 for October 1, 1987, reducing by 50¢ per year in 1988, 1989 and 1990 if purchases are projected to exceed a certain level. On the other hand, the 1985 act provides that the support price be raised if purchases are expected to total less than 2.5 billion pounds milk equivalent.

Reductions stipulated in the act for 1988-1990 are conditional upon a milk termination program better known as the whole-herd buyout, taking 12 billion pounds of milk off the market over an 18-month period. In the buyout, participating animals will be slaughtered or exported and the production recovery period will be slower. Production is expected to dip significantly in 1987, but by 1990, current conditions continuing, production could exceed even 1985 levels. As a solver of the surplus, the buyout program is predicted to have only a temporary effect.

Imports and Exports

Import quotas have been established in order to protect the dairy industry from other countries' dumping of dairy products onto American markets. New Zealand and Australia are the largest exporters of dairy products to the U.S. American imports and exports are relatively small: 1.6% and .4%, respectively (in 1976).

In recent years, imports of dairy products have exceeded exports. A large portion of U.S. exports, government-owned surplus products, are sent to reduce food deficiencies in developing countries.

Lobbying Efforts

Various lobbying groups work to assure that American dairymen have a unified voice that is powerful enough to cause action in the nation's legislative and administrative bodies. Lobbying groups have been established since the early 1900s and have been instrumental in protecting such legislation as the Copper-Volstead Act, which allows cooperatives to exist. Lobbying efforts are aimed at maintaining and improving the economic well-being of dairy farmers.

Summary

The U.S. government has played a significant role in the dairy industry for years, and current legislation would indicate it plans to continue. Although producers are often critical of federal programs, the intent has been to protect and support the dairy farmer. Dairy lobbyists also work within the governmental system to promote and strengthen the industry.

Credits

Kaiser, Harry M., ed. Proceedings of the Cornell Conference on Mandatory Supply Management Programs for the Dairy Industry. Ithaca, N.Y.: New York State College of Agriculture and Life Sciences, Cornell University, 1987.

Dairy: Background for 1985 Farm Legislation (Agriculture Information Bulletin No. 474). Washington, D.C.: Economic Research Service, USDA, 1984.

Dairy Organizations

American Dairy Association;
Dairy Research Inc.
6300 N. River Road
Rosemont, IL 60018
(312) 696-1020

Associated Milk Producers, Inc.
P.O. Box 32287
San Antonio, TX 78216

Association of Missouri Dairy Organizations
S103 Animal Science Center
University of Missouri-Columbia
Columbia, MO 65211
(314) 882-3470

Dairy Council of Greater Kansas City
5200 E. 45th St.
Kansas City, MO 64130

Mid-America Dairymen, Inc.
P.O. Box 1837
S.S. Station
Springfield, MO 65805

Midland United Dairy Industry Association
101 NE Trilein
Dairy Building
Ankeny, IA 50021
(515) 964-0696

Missouri Beef Industry Council
3632B W. Truman Rd.
Jefferson City, MO 65101

Missouri Dairy Association
S103 Animal Science Center
University of Missouri-Columbia
Columbia, MO 65211
(314) 882-3470

Missouri Dairy Herd Improvement Federation
S103 Animal Science Center
University of Missouri-Columbia
Columbia, MO 65211
(314) 882-6364

National Dairy Board
2111 Wilson Blvd., Suite 600
Arlington, VA 22201
(703) 528-4800

National Dairy Council
6300 N. River Road
Rosemont, IL 60018
(312) 696-1020

National Dairy Herd Improvement Association
3021 E. Dublin Granville Rd.
Columbus, OH 43229
(614) 890-3630

National Dairy Promotion and Research Board
2111 Wilson Blvd., Suite 600
Arlington, VA 22201
(703) 528-4800

National Mastitis Council
1840 Wilson Blvd.
Arlington, VA 22201
(703) 243-6111

National Milk Producers Federation
1840 Wilson Blvd.
Arlington, VA 22201
(703) 243-6111

Purebred Dairy Cattle Association
P.O. Box 126
Peterborough, NH 03458

St. Louis District Dairy Council
8710 Manchester Rd.
St. Louis, MO 63144
Area offices:
Columbia (314) 961-3100
Springfield (417) 862-1402

United Dairy Industry Association
6300 N. River Road
Rosemont, IL 60018
(312) 696-1020

Breed Associations

Ayrshire
Ayrshire Breeders Association
2 Union St.
Brandon, VT 05733
(802) 247-5774

Brown Swiss
Brown Swiss Cattle Breeders Association of USA
Box 1038 (800 Pleasant St.)
Beloit, WI 53511-1038
(608) 365-4474

Guernsey
American Guernsey Cattle Club
2105J S. Hamilton Rd.
Box 27410
Columbus, OH 43227
(614) 864-2409

Holstein-Friesian
Holstein-Friesian Association of America
1 South Main St.
Box 808
Brattleboro, VT 05301
(802) 254-4551

Jersey
American Jersey Cattle Club
Box 27310
Columbus, OH 43227
(614) 861-3636

Milking Shorthorn
American Milking Shorthorn Society
Box 1038
Beloit, WI 53511

Credits

Association newsletters and promotional mailers

The Dairyman Buyers Guide and Directory. Corona, Calif., 1985.

"Creation lies at the base of the world's entire civilization . . . to breed good dairy cattle is to create, and, when done in full recognition of economic requirements, is profitable. Animals of superior heredity were sought by the earliest breeders. And they will be sought by future generations."

--Karl B. Musser, Science of Providing Milk for Man by Campbell and Marshall, 1975

Cow Index Development

In developing a cow index, the following information is considered: 1) production records of individual, dam, individual's daughters, paternal and maternal half siblings, and herdmates, 2) sire's predicted difference and 3) lactation information (days in current lactation, number completed, number of milkings per day, age at calving, month of calving).

Using Cow Indexes to Select Replacements

Two types of cow index can be used when selecting replacements. The Estimated Average Transmitting Ability (EATA) is an estimate of the breeding value a cow will transmit to her offspring. This information provides breeders a fair, unbiased, comparatively accurate appraisal of the breeding worth of the individual and is similar to P.D. for dairy sires.

The USDA cow index gives the producer an estimate of a cow's genetic transmitting ability. Computer calculations are required in calculating this index because of complicated formulas and the large amount of information involved. The USDA cow index is used extensively for purchasing replacements, culling and selection of superior dams to produce A.I. sires.

Linear Classification

Dairymen who use trait evaluation as a guide in selecting sires and mating cows find they can improve production, increase the number of profitable lactations, reduce herd replacement numbers and realize more real profit.

Functional type traits affect the efficiency of a milking herd. Knowing the characteristics of a trait and how they contribute to the durability of the animal is important.

The linear program measures precisely and uniformly all descriptive functional traits known to have a bearing on the well-being of the animal. Without assigning desirability judgments to the trait, the linear program measures biological differences of the particular trait on a uniform scale.

A rating of the descriptive traits is based on measurements by the classifier. In most cases, these are not actual measurements made by rule or yardstick, but rather a measure taken by rating an animal's traits within a scale of biological extremes.

Form (includes stature, strength, body depth, angularity): The classifier must study a number of features before coming to a decision on form, such as the cow's measurement from the ground to the top of the withers, width and depth of the chest, muzzle width and substance of bone in the front end, depth of rib cage, rib openness, neck length, and sharpness and flatness of bone.

Rump (includes angle, length, width): Rump angle has a direct bearing on the reproductive performance of the cow since it allows for either proper or improper drainage of the reproductive tract. Rump width relates to calving ease; length is an indication of overall body length and capacity.

Legs and feet: This trait relates to the durability of the legs and feet through the set of the leg. From the side, the classifier can note the amount of set to the leg. The straighter or more posty the leg, the lower the rating. The more angular the leg from hock to foot, the higher the rating.

Udder (includes fore attachment, rear height, rear width, support, depth): The classifier observes traits such as strength of lateral ligaments and median suspensory ligaments, height and width of rear udder and depth of udder relative to the hocks.

Teats: Teat placement, as seen from the rear, is related to the ease of milking and to injury susceptibility. Extremely wide placement on the outside of the quarter is given a score of 1-5 points. Those which are extremely close to the bases on the inside quarter are rated 45-50 points.

A measurement scale of 1-50 points is used to show the biological placement of descriptive traits. These traits are measured to give a profile of the functional life of the animal and, further, to identify the genetic transmitting patterns of proven sires.

The linear classification program is designed to measure primary and secondary descriptive traits that provide the functional conformation of dairy animals. Primary traits are those known to have economic value and heritable importance. These traits offer sufficient variation within the breed that when differences are summarized they provide the basis for sire selection. Secondary traits are those for which less is known about their economic and genetic contribution. By gathering classification information on these traits, more can be learned about them through research. Management traits and conditions may also be included in the classification program. However, the herd owner, not the classifier, is encouraged to complete the work sheet voluntarily.

A final classification score is determined by rating the four major traits. In cows, these traits are general appearance, dairy character, body capacity and mammary system; in bulls, the same system applies, except for mammary system. Linear measurements of descriptive and management traits are separate evaluations and do not directly relate to the final score assignment.

Sire Selection for Artificial Insemination

Production of sires - Planned mating of superior cows and bulls can produce superior sires for artificial insemination.

First, superior cows must be identified. Look for a cow that produces 4,000+ pounds of milk above her herdmates and for half-siblings producing 2,000-3,000+ pounds above herdmates. Take note of cow families for desirable conformation type, longevity, good temperament and reproductive efficiency.

Mate the cow with a superior A.I. stud for high P.D. and repeatability. Semen collection from the offspring begins at 10-12 months of age. Then, in herds throughout the U.S., enough cows are mated with the young bull to obtain 50-100 production tested daughters. The bull is placed "on the shelf" for 4-6 years until daughters mature and provide milk production records. Bulls with high P.D.s are distributed for widespread use.

Sire selection - Various sire indexes can be utilized to select a dairy sire. With **daughter average** figures, selection is based on the average production of the sire's daughters. The **daughter-dam difference** considers the amount of increase or decrease in milk produced by a bull's daughters, as compared to their dams. The **equal-parent index** is based on the premise that the sire and dam contribute equally to the inherent milk-producing ability of the progeny. In it, the sire index is equal to twice the average production of daughters, minus the average production of dams. The **daughter-contemporary herd difference** substitutes herd average for dam's average production in daughter-dam difference index. The sire index is equal to the daughter's average minus the herd average. In the **daughter-contemporary herd index,** the herd average is substituted for the dam's average production in the equal parent index. The sire index is equal to twice the average production of daughters minus the herd average. With the **herdmate comparison,** a sire's daughters are compared with cows (herdmates) that freshen in the same herd during the same season of the same year. This index removes most environmental differences, such as the season of calving. In the **adjusted herdmate average,** each lactation of a sire's daughter is adjusted for comparison with one another.

Summary

Livestock selected and used for production becomes the foundation for the dairy enterprise. Incorporating tools such as cow indexes, performance evaluations and type evaluations should only serve to strengthen the program. Sire selection is of vital importance for the breeder to make genetic improvement within the herd. Many breed associations and organizations provide cow and sire evaluations, which further aid in the process.

Credits

"Your Introduction to the Holstein Association Linear Classification Program." Brattleboro, Vermont: Holstein-Friesian Association of America, 1986.

Campbell, John R.; Robert T. Marshall. The Science of Providing Milk for Man. New York: McGraw-Hill Book Co., 1975.

Powell, Rex L. "Computing Cow Indexes," Holstein World. Feb. 10, 1986: 30-32.

"Herd Ranking and Summary" (DHIA-204). Columbus, Ohio: National Dairy Herd Improvement Association, n.d.

DESCRIPTION OF TRAITS AND MEASUREMENT SCALE

ENVIRONMENTAL CONDITIONS

Lactation No.
Number of calvings or current lactation number

Date of Calving
Date of **last** calving

Time of Classification
Time of day when classification began

Time of Last Milking
Time of day when cows were last milked

LINEAR DESCRIPTIVE TRAITS

FORM

Stature
50
45 Extremely **tall**
40
35 Tall
30
25 Intermediate
20
15 Short
10
5 Extremely **short**
1

Strength
50
45 Extremely **strong** and wide
40
35 Very strong
30
25 Intermediate strength and width
20
15 Narrow and fair
10
5 Extremely narrow and **frail**
1

Body Depth
50
45 Extremely **deep** body
40
35 Deep body
30
25 Intermediate in body depth
20
15 Shallow body
10
5 Extremely **shallow** body
1

Angularity
50
45 Extremely **sharp** and angular with extremely clean, fine bone
40
35 Very sharp and angular with clean fine bone
30
25 Sharp and angular
20
15 Moderately angular
10
5 Thick and **coarse**
1

Relative Height at Front End
50
45 Extremely **high** front end, walks uphill
40
35 High front end
30
25 Intermediate in relative height level from rump to chine
20
15 Low front end
10
5 Extremely **low** front end compared to height of rump
1

Shoulder
50
45 Extremely tight **smooth** shoulder
40
35 Nearly tight shoulder
30
25 Intermediate
20
15 Definite open shoulder
10
5 Extremely **winged** shoulder
1

Back
50
45 Extremely **strong** back, roached back
40
35 Strong back
30
25 Intermediate strength back
20
15 Weak back
10
5 Extremely **weak** back
1

RUMP

Angle
50
45 Extremely **sloped** from hooks to pins
40
35 Moderate slope
30
25 Slight slope, hooks to pins
20
15 Pins slightly higher than hooks
10
5 **Pins clearly higher** than hooks
1

Rump Length
50
45 Extremely **long** rump, hooks to pins
40
35 Long rump
30
25 Intermediate in length
20
15 Short rump
10
5 Extremely **short** rump, hooks to pins
1

Rump Width
50
45 Extremely **wide** through pelvic area
40
35 Wide through pelvic area
30
25 Intermediate width of rump
20
15 Slightly narrow through pelvic area
10
5 Extremely **narrow** through pelvic area
1

Tailhead (relative to pins)
50
45 Extremely **high** and prominent tailhead
40
35 High tailhead
30
25 Intermediate position of tailhead
20
15 Low tailhead
10
5 Extremely **low** and depressed tailhead
1

Vulva Angle
50
45 **Vertical** vulva
40
35 Nearly vertical vulva
30
25 Intermediate vulva angle
20
15 Definitely tipped vulva
10
5 Extremely **tipped** or flat vulva
1

LEGS & FEET

Rear Legs, Side View
50
45 Extremely **sickled** in hock
40
35 Slightly sickled in hock
30
25 Intermediate set in hock
20
15 Nearly straight in hock
10
5 **Posty** and straight legged
1

Rear Leg Position
50
45 Extremely **forward**
40
35 Too far forward
30
25 Intermediate leg position
20
15 Too far back
10
5 Extremely **too far back**
1

Rear Legs, Rear View
50
45 **Straight** with no toe out
40
35 Straight with slight toe out
30
25 Nearly straight with moderate toe out
20
15 Close at hock, clearly toes out
10
5 Extremely **"hocked in"** sensible toe out
1

Mobility
50
45 Extremely **agile** and mobile
40
35 Very mobile
30
25 Intermediate mobility, no evidence of crampiness
20
15 Definite signs of crampiness
10
5 Extremely **crampy**
1

Foot Angle
50
45 Extremely **steep** foot angle
40
35 Steep angle
30
25 Intermediate angle
20
15 Low angle
10
5 Extremely **low** angle
1

Pasterns
50
45 Extremely **strong**
40
35 Definitely strong
30
25 Intermediate
20
15 Tend toward weakness
10
5 Extremely **weak**
1

Toes
50
45 **Closed** toes, tight
40
35 Nearly closed
30
25 Intermediate
20
15 Definite spread toes
10
5 Extremely wide **spread** toes
1

UDDER

Fore Attachment
50
45 Extremely snug and **strong** attachment
40
35 Very strong attachment
30
25 Intermediate strength attachment
20
15 Loose attachment
10
5 Extremely **loose** attachment
1

Rear Height
50
45 Extremely **high**
40
35 Very high
30
25 Intermediate height
20
15 Low
10
5 Extremely **low**
1

Rear Width
50
45 Extremely **wide**
40
35 Very wide
30
25 Intermediate width
20
15 Narrow
10
5 Extremely **narrow**
1

Support
50
45 Extremely tight and extremely **strong** support
40
35 Deep cleft, strong support
30
25 Clearly demonstrating both support
20
15 Cleft or attachment of good average strength
10
5 Negative with **broken** support
1

Depth
50
45 Extreme height of udder floor above hocks and **shallow** udder
40
35 Udder floor well above hocks
30
25 Udder floor above hocks
20
15 Udder floor at points of hocks
10
5 Very **deep** udder well below hocks
1

Fore (Udder) Length
50
45 Extremely **long** fore udder
40
35 Long fore udder
30
25 Intermediate in length
20
15 Short fore udder
10
5 Extremely **short** fore udder
1

Balance
50 Blind rear quarter
45 Severely tight rear quarter
40
35 Extremely **low front** quarters, tilted to front
30
25 Level udder floor
20
15 Extremely **low rear** quarters, tilted to rear
10
5 Severely tight front quarter
1 Blind front quarter

TEATS

Placement, rear view
50
45 Extremely **close**, base of teats in inside quarter
40
35 Placement in inside quarter
30
25 Centrally placed in quarter
20
15 Placement toward outside of quarter
10
5 Extremely **wide** placement on outside of quarter
1

Placement, side view
50
45 **Too far forward**
40
35 Forward placement
30
25 Centrally placed
20
15 Placement toward rear
10
5 **Too far back**
1

Teat Size
50
45 Extremely **large**
40
35 Large
30
25 Intermediate in size
20
15 Small
10
5 Extremely **small**
1

CLASSIFICATION TRAITS

General Appearance
Excellent
Very Good
Good Plus
Good
Fair
Poor

Dairy Character
Excellent
Very Good
Good Plus
Good
Fair
Poor

Body
Excellent
Very Good
Good Plus
Good
Fair
Poor

Mammary
Excellent
Very Good
Good Plus
Good
Fair
Poor

Final Score
Excellent
Very Good
Good Plus
Good
Fair
Poor

42

53

54

Credit: Linear Classification Manual. Brattleboro, Vermont: Holstein-Friesian Association of America, 1985.

Owner DOUGLAS, EDWARD

Address WHITE WATER, MN

HOLSTEIN-FRIESIAN ASSOCIATION OF AMERICA — RECORDING WORKSHEET

Page No. 14-2

LINEARIZED DESCRIPTIVE TRAITS

ANIMAL NUMBER	ANIMAL BARN ID / Date of Birth	Lact. No.	DATE OF CALVING Mo.	Day	Yr.	FORM: Stature	Strength	Body Depth	Angularity	Relative Height at Front End	Blockiness	Rank	RUMP: Angle	Length	Width	Tail Head	Valve Apart	LEGS & FEET: Rear Legs Side View	Rear Leg Position	Rear Legs Rear View	Hock Quality	Foot Angle	Pasterns	Toes	UDDER: Fore Attachment	Rear Height	Rear Width	Support	Depth	Fore Length	Balance	TEATS: Placement Rear View	Placement Side View	Size	CLASSIFICATION TRAITS: General Appearance (35%)	Dairy Character (20%)	Body (20%)	Mammary (35%)	Final Score
1 8258675	54 12-20-71	8	10	3	82	36	40	47	41				25	37	42		42	25		42		30			25	40	41	32	15			25			E	E	E	V	90
2 8479102	83 06-05-73	7	7	22	81	41	36	40	25			15	15	38	36	34	15	17	18			38			30	25	37	35	20			32			G	+	E	V	89
3 8701748	97 02-18-74	7	12	25	82	25	27	23	38		17		31	24	26			34				22			27	32	26	27	25			33	10		G	V	G	+	80
4 8701751	98 03-29-74	6	2	3	82	18	17	21	30				35	22	18			38		16	14	17	12		33	14	20	22	26			20			F	+	G	G	76
5 8830968	106 12-15-74	5	1	27	82	36	35	43	33				26	35	37			25				36			42	40	45	37	23			25			V	V	E	E	88
6 8912938	112 03-18-75	6	1	4	83	NIC - FRESH																																	
7 8974999	114 02-15-75	5	11	14	82	23	26	28	29				17	22	25	37		15				40			27	28	32	26	22			26			G	+	+	+	81
8 9121215	117 11-30-75	4	3	10	82	31	38	40	19	38			20	36	33		18	32				23		17	16	14	26	17	15		16	14			G	G	E	F	78
9 9227008	125 04-01-76	4	6	18	82	25	27	25	42				27	26	24			28				27			35	37	39	33	25			28	15		+	E	+	V	85
10 9422088	139 11-28-76	4	10	29	82	36	35	37	22				22	33	37			26			15	36			29	26	32	28	32			37			+	G	V	+	81
11 9422090	138 09-10-76	5	1	2	83	22	18	23	38				37	23	20			36		15		16	15	13	25	36	32	35	20	18		26			F	V	G	+	79
12 9607993	121 12-03-75	4	9	15	82	43	35	34	36				25	34	37			28	17			27			15	28	32	20	20			12			+	V	V	G	82
13 9607994	143 09-12-77	4	12	2	82	15	23	20	30			12	16	21	18			29				21			30	25	25	32	27			30	17	15	F	+	G	+	77
14 9608104	150 08-30-77	4	11	11	82	28	29	33	38		37		26	32	27			34				18			27	29	34	27	31			25			+	E	+	+	83
15 9608172	155 11-27-77	3	6	23	82	40	40	45	41			38	25	41	44			40	10	11		16	10		6	15	30	8	5			5		45	F	V	E	P	70
16 9806377	172 03-14-78	3	9	18	82	38	33	35	43				22	34	33			28				37			35	39	34	37	25			35			V	E	V	V	87
17 9806379	177 07-14-78	3	11	20	82	28	20	27	35				33	27	25	12		20				38			40	25	25	41	33			40			+	V	+	V	84
18 9953045	183 08-22-78	3	10	12	82	45	30	32	37				10	33	37			18		40		45			15	32	30	33	25			15			G	V	V	G	80
19 10006618	190 03-12-79	2	5	5	82	29	26	27	5				26	30	25			14	14			35			30	22	27	18	32			18			G	F	+	G	76
20 10177808	194 04-15-79	2	7	8	82	37	40	35	30				28	36	30			37				22			10	8	11	25	20	37		20		40	G	+	E	F	78
21 10178004	207 06-03-79	2	8	13	82	32	30	30	37				25	31	27	34		40				14	10	12	34	28	27	33	28		45	34			F	V	V	+	79
22 10291877	218 01-23-80	2	12	27	82	11	8	14	25	11			40	21	14			36				12			25	15	14	25	40		35	40		10	P	+	F	G	66
23 10326337	215 12-25-79	1	1	30	82	37	23	20	36	16			37	36	30			29				33			40	38	37	41	38			37			+	V	+	V	83
24 10326338	224 02-09-80	1	2	2	82	26	18	17	40		15		28	22	14			31				18			28	23	20	27	32	12		20			G	V	G	G	78
25 10431320	230 04-22-80	1	5	31	82	17	10	12	20				22	20	18		10	17				34			30	22	18	22	37		40	19			F	G	F	G	73

Time of Classification 9:00 AM Time of Last Milking 6:00 AM Classifier M.S. Classifier Date 1-6-83

55

Credit: Linear Classification Manual. Brattleboro, Vermont: Holstein-Friesian Association of America, 1985.

56

Failure of cows to conceive and calve on a 12- to 13-month interval can result in annual losses of milk and calf sales, increased dry cow feed cost, and added replacement and semen costs. Additional costs can result from the loss of genetically superior cows and possible genetic advancement because of failure to conceive.

Artificial Insemination

Some advantages of using artificial insemination instead of natural mating are as follows.

1. Increases the use of outstanding sires
2. Alleviates the danger and bother of keeping a bull
3. Makes it possible to overcome certain physical handicaps to mating
4. Lessens sire costs when using very valuable sires
5. Reduces the likelihood of costly delays from using infertile bulls
6. Helps control diseases such as leptospirosis
7. Makes it feasible to prove more sires
8. Creates large families of animals
9. Increases pride of ownership
10. Alleviates distance and time as limiting factors of mating
11. Increases profits

Some disadvantages of A.I. include the following.

1. Cows must be checked for heat at least twice a day.
2. Special training and considerable practice is required to maintain insemination skills.
3. Added time and labor is necessary to breed the cow.
4. Special equipment and supplies are required if producers do their own insemination.
5. Caution must be used with semen storage. Maintain adequate level of liquid nitrogen in the storage tank. Tank damage can result if semen must be transported from farm to farm.

Embryo Transfer

Through the administration of hormones, as many as 50 ova (eggs) can be obtained from a cow in one estrous cycle. Although certain injections fail to produce any eggs, multiple attempts may allow a producer to obtain several calves from a valuable cow during a year's time. This speeds up the rate of progress in genetic improvement within the herd. Valuable cows that produce normal ova but fail to conceive due to some hormonal or anatomical defect do not need to be culled because of sterility. Heifers can be effectively progeny tested at an early age, reducing generation length by a year or more. Genetically inferior cows can be made more productive by using them as incubators.

Embryo transfer is a seven-step process.

1. Synchronize heat cycles of donor and recipient cows.
2. Administer a drug to the donor cow to cause superovulation.
3. Breed donor cow (A.I. or natural).
4. Collect ova from donor cow five days after breeding.
5. Examine eggs to determine whether fertilized.
6. Prepare recipient.
7. Transfer fertilized egg to recipient cow.

Reproductive Health Programs

Dairy producers should consider two reproductive health programs. First of importance is vaccination for prevention of reproductive diseases such as brucellosis, leptospirosis and vibriosis. Second, routine veterinarian palpation of breeding animals determines the presence of infection in the reproductive tract, presence of cystic ovaries, occurrence of normal estrous cycle and stage of pregnancy.

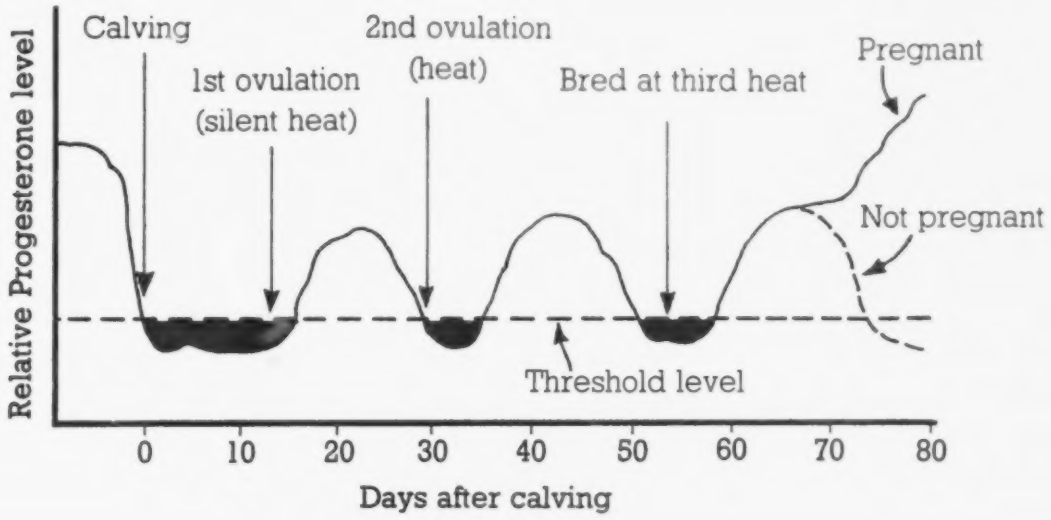
Reproductive Technology

Ultrasound - This procedure reflects a characteristic pattern of echoes from surfaces such as the boundary between a pregnant uterus, its surrounding tissue and contents. Ultrasound can accurately detect pregnancy as early as 30 days. It can aid in culling open cows; makes rechecking pregnant cows easy; and helps spot problems such as uterine infection, cystic ovaries and postpartum abnormalities.

Milk progesterone testing - This procedure makes it possible to accurately monitor the reproductive status of cows. The test verifies heat, aids in diagnosing pregnancy, aids in monitoring heat cycles after calving and helps screen for ovarian dysfunctions. Progesterone is a hormone produced by the corpus luteum (CL) of the ovary. The CL develops on the ovarian site where the follicle ruptures and releases the ovum (egg). Progesterone is secreted into the blood and subsequently into the milk. Testing milk for progesterone levels can be used for the same diagnostic purposes as testing blood, and milk samples are easier to obtain.

Progesterone levels increase about four days after heat, remaining high until 17-18 days after heat. If the released egg is not fertilized, the CL degenerates and progesterone levels decline to near zero. When the cow does conceive, the CL persists; progesterone levels do not decline but increase and remain elevated during pregnancy. Figure 14.1 illustrates the normal pattern of changes in milk progesterone levels as a cow resumes estrous cycle activity and becomes pregnant after calving.

FIGURE 14.1 - Normal pattern of a cow's progesterone cycle after calving



Embryo sexing - This is part of the newer technology associated with embryo transfer. In the future, producers will have the option of placing a heifer or bull embryo from superior parents into a recipient cow. This will enable producers to market unborn offspring by guaranteeing the gender of the calf.

Prostaglandin - This hormone is used for heat synchronization. It is produced by the uterus and causes the natural regression of the CL on the ovary. If prostaglandin is injected into heifers/cows between the fifth and eighteenth days of their estrous cycle, the CL will degenerate and the females will be in heat 2-4 days after the injection. Prostaglandins can be used as an aid in freshening heifers at 24 months of age. It can be used to rebreed cows known to have silent heats. Synchronized females can be bred in groups so they will calve at the same time.

Summary

In the near future, producers may call the inseminator to implant an embryo just as commonly as they now call for A.I. service. Although new technology such as embryo transfer and embryo sexing may greatly improve reproductive efficiency, basic problems such as detecting heat can render the new technology ineffective. A sound reproductive health program can save the producer hundreds of dollars per year in lost production and added feed cost. Scientists are continually developing new products to increase efficiency. Innovative and forward-thinking producers use this technology as a tool to increase the productivity of their dairy enterprises.

Credits

Ensminger, M. E. Dairy Cattle Science, 2nd ed. Danville, Ill.: Interstate, 1980, pgs. 78, 82-83, 358.

Nebel, Ray L. "Here's How Cowside Milk Progesterone Tests Work," Hoard's Dairyman. May 10, 1986: 466.

Quinn, Thomas. Dairy Farm Management. Albany: Delmar, 1980, pg. 121.

Seidel, George E. Jr.; R. Peter Elsden. "Embryo Technology," Hoard's Dairyman. Jan. 10, 1986.

UMC Extension Division agricultural guides

a) G3011: Reproductive Dairy Herd Health Program--Routine Examinations (1980)
b) G3012: Detecting Heat in Dairy Cows (1975)

"Cow and Mare Pregnancies Mean Profits." Aurora, Colo.: Animark, Inc., n.d.

"Synchronized Breeding of Dairy Heifers" (special circular 272). University Park, Penn.: Cooperative Extension Service, The Pennsylvania State University, 1981.

Waste Handling

A number of factors should be considered when planning an waste-handling system for a dairy operation.

Effluent volume - The liquid waste resulting from milking and cleaning can consist of liquid manure diluted with feed, bedding and hoof dirt; diluted milk and cleaners from equipment washing; concentrated milk products (colostrum, medicated or spilled milk); and clean water from final pipeline rinse and water-cooled condenser.

Manure volume - Mature cattle produce 6-8% of their body weight in manure each day; a 1,000-pound cow will produce 60-80 pounds of waste daily. Fresh manure, a mixture of urine and feces, is about 12% solids.

Bedding volume and type - Bedded housing usually requires that manure be handled as a solid. Wooden materials, such as sawdust, are satisfactory bedding and cause few liquid manure handling problems.

Collection systems - Slatted floors require less labor and are suitable for animals of all ages. Advantages of using scrapers and blades include reduced labor requirements and fewer odors because of frequent manure removal. However, corrosion and deterioration of equipment can be a problem. Also, a small tractor with blade can be more dependable during cold weather. Front-end loaders are usually limited to straight runs and areas with few turns. Skid-steer loaders work more easily in tight quarters. In flushing systems, large volumes of water flow down a sloped alley, carrying manure to an outside storage. Adequate cleaning requires 100 gallons of water daily per 1,000 pounds of live weight. Performance can be reduced when outside temperatures stay below 20-25F. With a gravity-flow channel, manure flows naturally down the inclined surface, so no mechanical equipment is needed. Gravity-flow channels can be used with slatted floors. The biological activity helps to liquify the manure and maintain a constant flow.

Liquid manure storage - There are three basic types of storage for liquid manure. In a below-ground system, waste is stored below ground-level in tanks which are designed to withstand all anticipated earth, hydrostatic and live loads. Earth-storage basins provide long-term storage with a moderate investment. They are constructed to prevent ground and surface water contamination. Above-ground storage is expensive, as compared to earth basins, but it is an alternative where basins are limited.

Solid manure storage - In planning a storage system, provide convenient access for filling and unloading. Locate the storage for year-round access. Finally, design for adequate capacity, taking into consideration the number and size of animals, type and amount of bedding, and desired storage period.

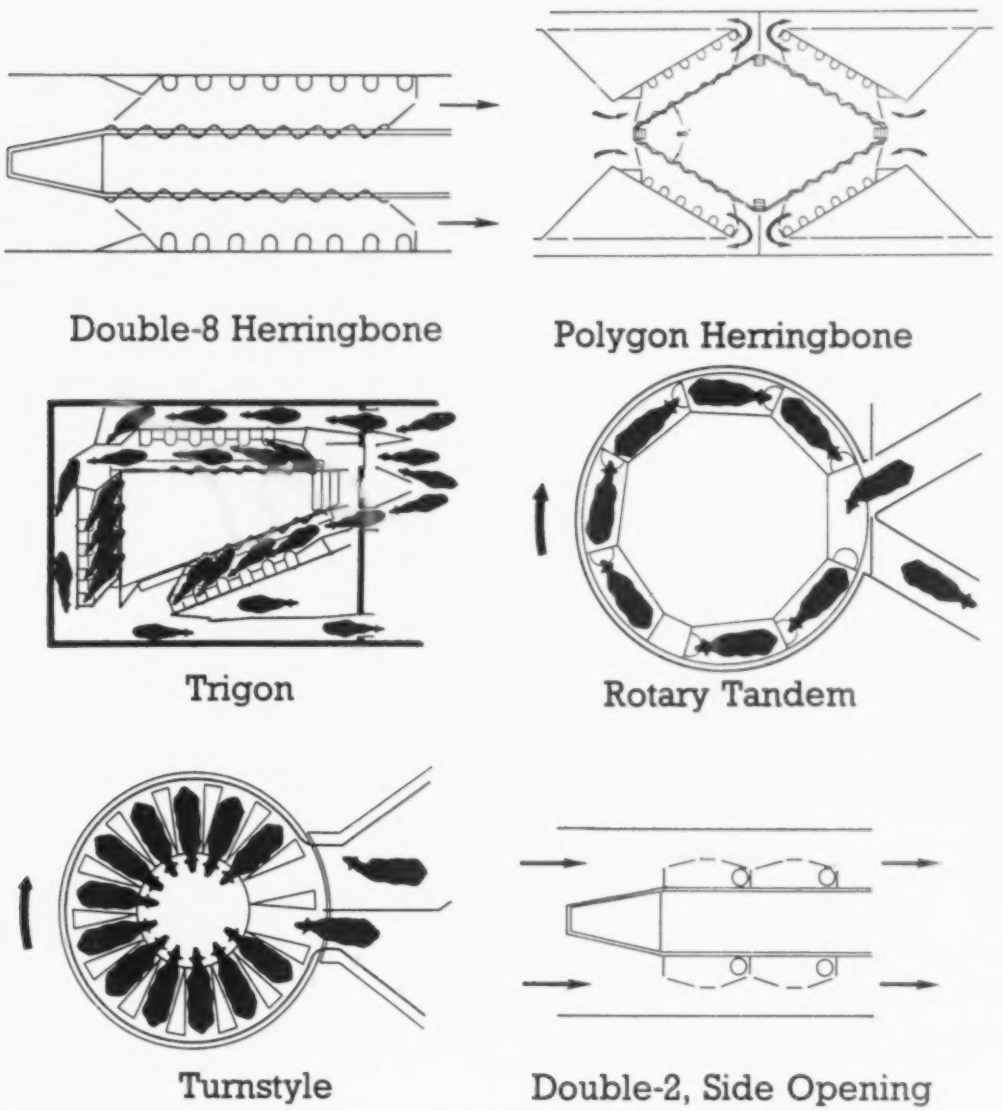
Handling systems - For solid waste, spreader mechanisms include paddles, flails and augers. The mechanisms used should spread manure uniformly. For handling liquid waste, which can be up to 4% solids, there are irrigation

systems or sprayers mounted on tank wagons. Slurries (4-15% solids) must be agitated before pumping and require high pressure to pump long distances.

Credit

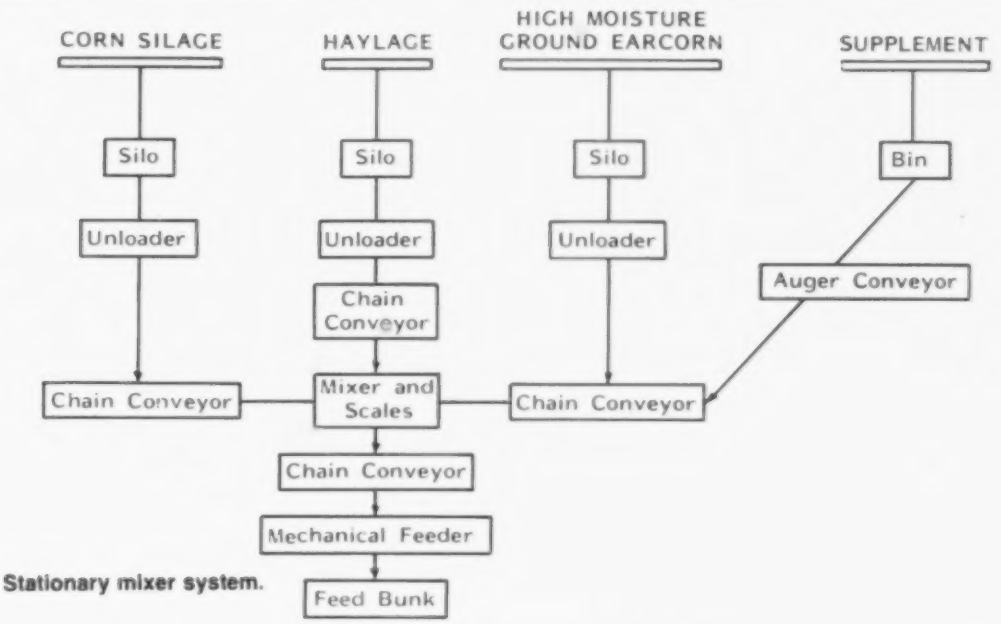
Dairy Housing and Equipment Handbook (MWPS-7), 4th ed. Ames: Midwest Plan Service, Iowa State University, 1985.

FIGURE 15.1 - Milking parlor designs

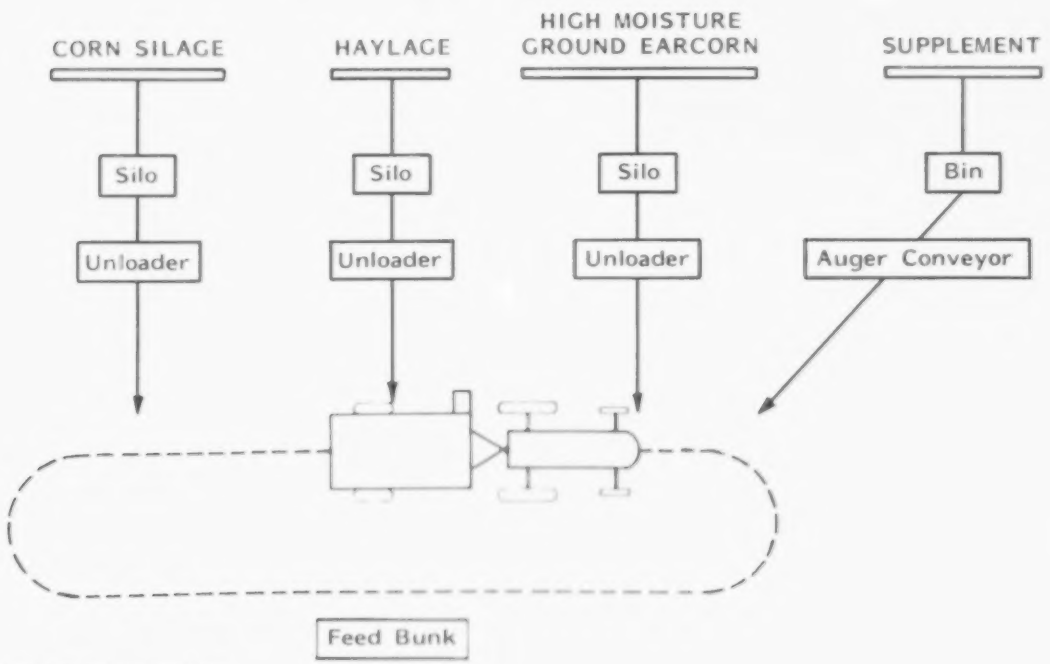


Credit: Adapted from extension publications from Michigan State University, Western Regional Extension Publications and the University of Arizona.

FIGURE 15.2 - Feed mixing systems



Stationary mixer system.



Mobile mixer system.

Credit: Dairy Housing and Equipment Handbook (MWPS-7), 4th ed. Ames: Midwest Plan Service, Iowa State University, 1985, pg. 9.2.

Categories of Dairy Diseases

Metabolic - This pathological condition results from a disturbance in a normal metabolic pathway. Proper nutrition will drastically reduce the incidence of metabolic diseases. These diseases include milk fever (parturient paresis), ketosis and grass tetany.

Reproductive - More than half of all infertility in cattle results from infectious diseases of the reproductive tract. The four major diseases are brucellosis, leptospirosis, trichomoniasis and vibriosis. Metritis, though not infectious, is another reproductive disease that is an inflammation often caused by calving difficulties.

Parasitic - Parasites, both external and internal, present only minor problems in well-managed dairy herds. Internal parasites include intestinal roundworms, lungworms, coccidiosis, liver flukes and grubs. External parasites include lice.

Infectious - Infectious diseases vary in importance regionally and seasonally throughout the country. Common diseases include mastitis, Bovine Virus Diarrhea (BVD), foot rot, Infectious Bovine Rhinotracheitis (IBR, rednose), Para-Influenza-3 (PI-3), anaplasmosis, blackleg, Bovine Respiratory Syncytial Virus (BRSV), pinkeye and warts.

Vaccination Recommendations

Vaccination programs vary greatly, from the minimum, state-required calfhood vaccination for brucellosis to complex programs covering a wide range of diseases. A relatively simple vaccination program follows.

1. Brucellosis: required by state law at 4-11 months
2. Blackleg: 2-3 months and again at 5-6 months
3. IBR, BRSV and PI-3: four months, repeat at 12 months
4. BVD: can be given with IBR at four months and also 8-12 months
5. Leptospirosis: 30 days postpartum
6. Vibriosis: combine with leptospirosis for herds using natural mating

Mastitis Control

Mastitis may be either infectious or non-infectious. Infectious mastitis results from the udder's invasion by bacteria, while non-infectious mastitis is the result of injury, chilling, bruising or rough or improper milking. Measures for preventing the disease and its spread include the following.

1. Milk all diseased cows last.
2. Use a strip cup before milking.
3. Wash udders with clean, individual towels soaked in a chlorine solution.
4. Wash and dry hands before milking.

5. Remove teat cups immediately when milk flow stops.
6. Dip teats in a chlorine solution after milking.
7. Periodically check rubber parts and vacuum of milking machine.
8. Keep facilities and equipment sanitary at all times.
9. Do not purchase mastitis-infected cows or replacements.

Diseases Affecting Humans

More than 90 different types of infectious and parasitic diseases can be transmitted from animals to humans. Of most concern, however, are brucellosis (undulant fever in humans), anthrax, Q fever, rabies, ringworm, tuberculosis, leptospirosis, and foot-and-mouth disease.

Credits

Bath, Donald L., et. al. Dairy Cattle: Principles, Practices, Problems, Profits, 2nd ed. Philadelphia: Lea & Febiger, 1978, pg. 412-424.

Campbell, John R.; Robert T. Marshall. The Science of Providing Milk for Man. N.Y.: McGraw-Hill, 1975, pg. 300-305.

Ensminger, M. E. Dairy Cattle Science, 2nd ed. Danville: Interstate, 1980, pg. 361-382, 376.

Quinn, Thomas. Dairy Farm Management. Albany: Delmar, 1980, pg. 411-412.

The time spent improving the genetic ability of a cow to produce milk will not be realized if proper nutrition limits the individual's ability to produce to her potential. Since feed costs represent 40-50% of the total cost of producing milk, feeding the correct amount of a balanced ration can reduce feed costs while increasing production.

Purpose of a Forage Analysis

A forage analysis is helpful in determining two components: quality (nutrient concentration) and moisture content. Knowing a forage's quality is important since forage accounts for a minimum of one-third of the ration. Forage quality (fiber) affects forage intake and will determine the quantity and nutrient content of grains to be fed. Understanding the amount of moisture in a forage is important when selling and purchasing feeds, as producers do not want to pay for water. Moisture content is critical when balancing rations since water contains no nutrients but adds to the ingredient's weight.

Sampling Forages

To take a proper sample, assemble needed equipment first. This includes a hay probe or forage sampler, which is a tube with a sharp cutting edge that can be turned by hand, brace or electric drill. With this, gather plastic sample bags, a pail and information sheets.

The second step is to pick the crop to be sampled. Select only one sample per type of hay. Forage samples differ based on several elements.

1. Species of legume or grass
2. Weed content
3. Stage of maturity
4. Rainfall/temperature
5. Number of cuttings taken

In taking the samples, gather 12 subsamples per forage type, mix the samples in the pail, place the composite sample in the plastic bag and number each.

To finish the sampling, fill out the information card, recording the sample number and type of feed for later reference. Wrap and mail the sample to a laboratory which does forage analysis. A county extension agent should be able to recommend a forage analysis laboratory.

Interpretation of a Forage Analysis

Percent moisture and dry matter - This section will discuss three methods of measuring moisture content which use specific equipment: the Delmhorst moisture tester, the Koster tester and the microwave oven.

The Delmhorst moisture tester is a convenient hand-held device that estimates moisture of 13-40% by measuring its electrical resistance.

The Koster moisture tester is a portable, forced air, electric drying unit. A small scale that comes with the heater is used to weigh forage in a mesh-bottom basket. The basket is put into the drying device and dried for approximately 30 minutes. Use the dry matter/moisture readings on the scale when stable readings occur. An electrical outlet or portable generator is required to use this type of tester.

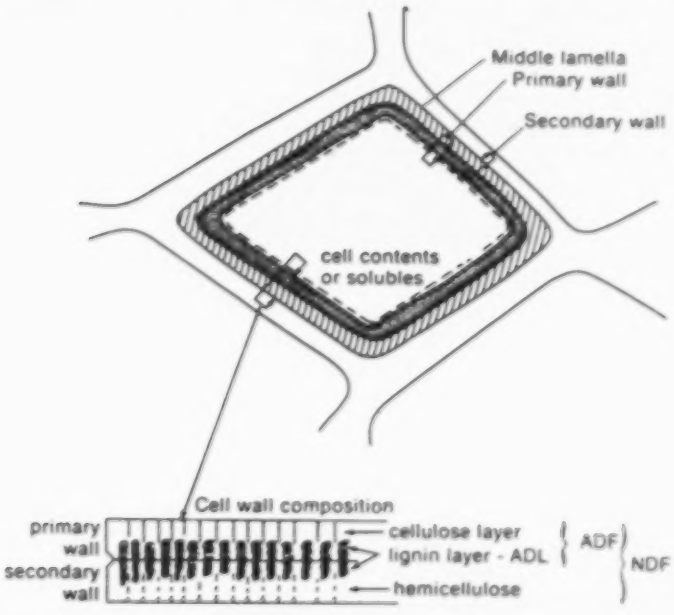
Microwave ovens can be used to dry forage in a minimum amount of time. For more information on this technique, see the Guide 3151 published by the University of Missouri-Columbia Extension Division.

A common but imprecise way to measure a forage's moisture content is to squeeze it into a ball for 30 seconds and then guess the moisture level.

Percents of protein and energy - Detergent fiber analysis separates a forage into two parts: the cell solubles, which include starches, proteins, sugars and other compounds which are highly digestible; and detergent fibers, which provide structural support for the plant and are lower in digestibility. Refer to Figure 17.1 to illustrate plant cell make-up.

See UMC Extension Division Guide 3160, reprinted in this lesson, for more information on soluble cell tests.

FIGURE 17.1 - Plant cell composition



Neutral detergent fiber - Also called cell wall, this component is measured by boiling a forage sample in a special detergent of a neutral pH of 7, filtering the boiled sample through filter paper. The liquid passing through the filter contains starch, sugar, protein and other compounds that were dissolved. The remaining residue is called NDF or cell wall. After drying, the NDF is calculated as a percentage of the original forage sample.

NDF contains all the fiber found in the forage and consists of the following components--hemicellulose, cellulose and lignin. NDF ranges from 20-80% digestible, depending upon forage species and maturity stage. NDF also maintains the original bulk of the feed and is responsible for rumen fill.

Total digestible nutrients (TDN) - This factor indicates the relative energy value of a feed to an animal. It is determined by adding digestible components such as crude protein, crude fiber, nitrogen-free extract and crude fat. It does not include digestible mineral matter.

Home-mixed vs. Commercially Mixed Rations

Commercial feed manufacturers can offer feeds such as complete dairy concentrates, dry cow rations, growing or young stock rations, calf starters, milk replacer feeds, protein supplements, and mineral and vitamin premixes.

Advantages that commercial feed manufacturers have include purchasing feed in quantity lots at volume discounts, using computers for purchasing, having the facilities to manufacture specialty feeds, hiring scientifically trained personnel to determine rations, and processing and mixing economy and control.

Home-mixed feeds allow the use of lower-cost, home-grown grains and eliminating the need for the profit margin usually associated with commercial feeds. Also, home-mixed feeds allow the producer to know the ration's exact contents.

Additional preparations are required to home-mix feeds, however. The producer must take into consideration the cost of ingredients needed to balance the ration, cost of grinding and mixing, time and labor required for mixing feeds, cost of feed-handling facilities and knowledge required to balance the ration.

Commercial and home-mixed feed principles can be combined for best use of all resources. Many local feed mills will custom-mix feeds, which eliminates the producer's need for bulk ingredient-handling facilities and frees time to engage in other activities. Producers can design their own feeding program since they have access to all ingredients used by the feed mill. Least costly ingredients can be chosen for ration formulation. With custom mixing, producers have exact knowledge of the ration's contents. Custom rations can often be purchased at a lower cost than pre-mixed, manufactured rations of the same protein content.

Credits

University of Missouri-Columbia Extension Division agricultural publications

a) G3150: Forages for Cattle (1986)
b) G3151: Using a Microwave Oven to Determine Moisture in Forages (1986)
c) G9650: Sampling Feedstuff for Chemical Analysis (1976)

Cullison, Arthur E. Feeds and Feeding. Reston, Va.: Reston Publishing Co., Inc., 1975, pg. 46.

Ensminger, M. E. Dairy Cattle Science, 2nd ed. Danville, Ill.: Interstate Printers and Publishers, 1980, pg. 264-265.

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Understanding and interpreting feed analysis reports

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The feed analysis report may include some unfamiliar terms. This guide explains those terms and their use.

Acid detergent (AD) fiber and Neutral detergent (ND) fiber. These designations measure different fiber components. AD fiber, used in place of crude fiber, gives a more accurate estimation of net energy than crude fiber. A forage test is necessary to determine AD fiber because forages vary greatly. Early-cut forages have lower AD fiber and a higher net energy than late-cut forages. Legumes generally have lower AD fiber and a higher net energy than grasses at comparable stages of maturity. *Book values* for net energy in grains can be used for formulating diets because the low fiber and high net energy values for grains are quite constant. More information about forage fiber determination and feed values can be found in UMC Guides 3105, 3108, 3150 and 2067. Neutral detergent (ND) fiber is explained in Guide 3150.

Net Energy (NE) and Total Digestible Nutrients (TDN). These values measure the energy in feed that is available for maintenance, growth or lactation. Net energy is expressed in megacalories (Mcal) per pound of feed and TDN in percent. Net energy is not equivalent to TDN and should not be used interchangeably. Three net energy terms are provided: net energy lactation (NE lactation), net energy maintenance (NE maint. or NE_m), and net energy gain (NE gain or NE_g).

For dairy cows, NE lactation is the correct term. NE lactation of a food includes energy for maintenance and milk production. A 1500-pound cow producing 60 pounds of 3.5 percent milk needs 10.66 Mcal of NE for maintenance and 18.60 Mcal of NE for milk production for a total of 29.26 Mcal. UMC Guide 3105 explains how to get these values. If this cow is eating 25.0 pounds of alfalfa hay, she will consume 13.75 Mcal (25.0 lb X .55 Mcal per pound as fed). She will need 15.51 Mcal from 20.68 pounds of grain (15.51 Mcal ÷ .75 Mcal per pound as fed). (Table 2.)

Table 2.

Total Daily NE lactation Requirement (1500 pound cow)		**29.26 Mcal**
NE lactation from feeds:		
25.00 lbs alfalfa hay	X .55 Mcal/lb as fed	13.75 Mcal
20.68 lbs grain	X .75 Mcal/lb as fed	15.51 Mcal

Table 1. Sample Feed Analysis Report

(Sample Number)	**79-26-K-21**		**79-26-K-22**	
(Sample I.D.)	**Alfalfa**		**Grain Mixture**	
	As Fed Basis	*Dry Matter Basis*	*As Fed Basis*	*Dry Matter Basis*
Moisture %	10.93		14.90	
Dry Matter %	89.07	100.00	85.10	100.00
Crude Protein %	16.00	17.96	19.13	22.48
ADF-Nitrogen Unavailable Protein %	2.67	3.01		
Adjusted Crude Protein %	16.00	17.96		
A.D. Fiber %	29.70	33.34	5.00	5.88
N.D. Fiber %				
NE Lactation Mcal/lb	.55	.62	.75	.88
NE Gain Mcal/lb	.28	.31	.54	.63
NE Maint. Mcal/lb	.50	.56	.84	.99
TDN %	50	56	73	86

For growing and finishing cattle, NE maintenance and NE gain are used separately for calculating the required energy. A 600-pound steer, gaining 2.0 pounds daily, requires 5.17 Mcal NE_m and 3.54 Mcal NE_g (UMC Guide 2067). How much would a 600-pound steer eating 10 pounds of alfalfa hay and 7 pounds of grain be expected to gain daily? The answer is 1.97 pounds by the calculation in Table 3.

Table 3.

Find NE_m and NE_g content of ration using values given in feed analysis report.

	NE_m	NE_g
	Mcal	Mcal
10 lbs alfalfa (as fed)	5.00 (10 lb X .5 Mcal/lb)	**2.80**
7 lbs grain (as fed)	5.88 (7 lb X .84 Mcal/lb)	**3.78**
17 lbs total ration	10.88	**6.58**
Mcal per lb. of ration (as fed)	0.64 (10.88 Mcal ÷ 17 lbs)	**0.39**

Maintenance must be met first. Calculation of pounds of ration needed to meet the maintenance requirement of 5.17 Mcal is 5.17 Mcal NE_m ÷ 0.64 Mcal NE_m/lb of ration = 8.08 pounds of ration. The remaining portion of the ration, 8.92 pounds (17 lbs - 8.08 lbs), can be used for gain. 8.92 lbs. X 0.39 Mcal NE_g/lb. (= 6.58 Mcal/17 lbs. of ration) = 3.48 Mcal NE_g. The 600-pound steer requires 1.77 Mcal NE_g per pound of gain; therefore, 1.97 pounds (3.48/1.77) is the expected daily gain.

The amount of the ration needed above maintenance for a 2.0-pound daily gain is 9.08 pounds (3.54/0.39). Total daily intake of the mixed ration to give 2.0-pound daily gain is 17.16 pounds (8.08 + 9.08).

Total digestible nutrients (TDN) requirements for beef cattle are listed in UMC Guide 2067. To calculate rations, divide the animal's daily TDN requirement by the TDN level in the ration. Example: 10.7 pounds TDN are required for a 600-pound steer to gain 2.0 pounds daily. If the ration contains 63 percent TDN (10.7 ÷ .63 =) 17.0 pounds of feed is needed daily.

Unavailable Protein (Including Heat Damaged Protein). This is the protein that the cow cannot digest, measured as ADF-N or pepsin insoluble protein. A small amount of unavailable protein, (ADF-N X 6.25) is normally found; this is usually 3.0 percentage units or less. Amounts greater than 3 percent indicate heat damage.

Heat damage increases the amount of unavailable protein in forages. To compensate, increase the protein content of the grain or feed a different forage.

Adjusted Crude Protein. This is the amount of crude protein after heat damage has been subtracted. Adjusted crude protein is the same as crude protein if there is no heat damage. Use the adjusted crude protein value to formulate rations. (Table 4.)

Table 4

Protein Fractions of Normal and Heat Damaged Forages.

	Normal Forage	Heat Damaged Forage
Crude Protein %	18.0	18.0
Unavailable Protein %	3.0	10.0
Heat Damaged Protein %	0 (3.0 − 3.0)	7.0 (10.0 − 3.0)
Adjusted Crude Protein %	18.0	11.0

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There are thousands of acres of Missouri farmland that are best utilized by forage production. Ruminants like the dairy cow are efficient harvesters this forage. Forages can provide a high-quality feedstuff that may replace high-priced concentrates in a ration. With careful management, forage production can be incorporated into the dairy enterprise to make it more profitable.

Forage Alternatives

Green chop - Fresh herbage is cut and chopped in the field for transportation to confined animals. Points to consider when feeding green chop include a daily minimum of 100 lbs. of green chop per lactating cow; the need for a supply of hay or silage in case of machinery failure; and how much time, machinery, investment and labor will be required.

Using green chop is advantageous because it increases land carrying capacity 30-50%; makes distant, small and scattered pastures more practical to use; reduces refused and wasted forage; and alleviates need for fencing, water and shade in pastures.

Drawbacks to feeding green chop include a higher harvesting cost, forage quantity and quality variations, the need for spreading manure mechanically, and the chance of bloat and toxicity.

Silage - This fermented forage has been widely used for a number of reasons. It retains a higher proportion of plant nutrients than hay does, produces the maximum quantity of feed per acre and is a feasible, top-quality feed during bad weather. Silage requires less storage space than hay and helps control weeds by removing all plant material during harvest. In addition, it is the cheapest form of succulent winter feed, is very palatable and causes little or no bloat problems.

There are also disadvantages to silage use. A silo and special equipment are required for harvesting and storage; silage requires handling 2-3 times more tonnage than hay because of high water content. Silage has less Vitamin D than sun-cured hay. Less organic material returns to the soil because all manure is collected in one area.

Hay - Hay usage has several benefits for the producer. Nutritionally, it can be used as supplement to high-moisture feeds to maintain proper microbial action in the rumen. Hay provides an important source of relatively cheap energy and reduces the incidence of ketosis and displaced abomasum. Management-wise, hay can be used to offset high concentrate prices and can be packaged to meet labor and handling resources. It also prevents a lowering of milkfat content in lactating cows.

Shortcomings of hay include its variance in nutrient content and palatability. The nutritional needs of high producing cows cannot be met by hay alone. Quality and feeding value can drop during rain curing, sun bleaching, handling when too dry and storing when wet. During harvesting and feeding, a greater

volume of plant material is lost. Also, wet hay may generate enough heat to cause spontaneous combustion and fire in barns.

Hay-making systems include long, loose hay; chopped hay; conventional square and large round bales; large, machine-made stacks, cubes and pellets.

Pasture Selection

Performance - Pasture can strongly influence dairy cow performance. Cows will produce at two-thirds of their maximum capacity when good-quality forage is the sole dietary ingredient. Production is often limited by the low amount of available energy in forage. Rations containing 50% dry matter concentrates will increase milk production about 50% over production obtained with forage alone.

Nutrition - The constituents of forage affect reproduction. Energy is most affected by a forage's digestibility. To maintain the highest level of digestibility, select the species type to match changing seasons. Protein is necessary for maintenance, growth and production. Forages having 18% C.P. or above should meet all needs of a high producing cow. Legumes are generally higher in protein than grasses.

Minerals and vitamins are vital for maintaining high production. Cows producing more than 30 lbs. of milk daily need supplemental calcium and phosphorus. A selenium deficiency is related to poor reproductive performance in dairy cattle and may be caused by low selenium uptake by plants. A deficiency in magnesium causes grass tetany. Magnesium is sometimes poorly utilized when contained in forage. Vitamins A, D, E and K are found in green leafy forages; care must be taken when feeding cows silage during the winter because silage is often deficient in vitamins A, D and E.

Legumes vs. grasses - Generally higher in crude protein and plant cell solubles, legumes also contribute to increased production and add nitrogen to the soil. Grasses, on the other hand, have a good soil-holding ability and stand persistence. Most producers find that a combination of grasses and legumes often provides the best forage system.

Large herds - Pasture consumption by dairy cows has dropped 50% since 1960 because high land values have forced large dairies to use their land resources more efficiently (i.e. dry lots). Pasture costs include fencing, water supply and barn access. A uniform high yield is difficult to maintain on pasture.

Missouri forages - Common grasses grown in Missouri include bluegrass, tall fescue, orchardgrass, timothy, bromegrass and reed canarygrass. Frequently seen legumes are alfalfa, red clover, white clover, lespedeza and birdsfoot trefoil.

Buying Roughage

Roughage quality affects the type, amount and protein content of other feeds needed to balance the ration. An analysis should be done on each load of purchased forage.

The value of a forage can be determined by comparison with a protein supplement such as soybean meal. Determine the value of one pound of protein as follows. This analysis works best when compared feeds have similar nutritional values.

$$\text{Protein cost (1 lb.)} = \frac{\text{Price of 100 lbs. of feed}}{\text{\% protein of feed}}$$

Since transporting water can become costly, a forage's feeding value should be determined on a dry matter basis. Rations need to be adjusted to an "as fed" basis to determine the actual pounds of forage to be fed.

Local ads or guides such as the Missouri Department of Agriculture's Missouri Hay Directory can help locate forage for sale. Consider that the final cost of forages can be greatly increased due to transportation charges.

Forage Equipment

Hay systems - Tractor-drawn mower conditioners cut forage and crush the stem to allow for faster drying. Self-propelled swathers cut forage, condition it and form the windrow. A tractor-drawn rake is used to turn the swath cut by the mower, reducing drying time. Conventional hay balers form small square bales of hay, and automatic bale wagons cut labor requirements by loading the bales as they come from the baler.

A large round baler produces round bales of hay weighing 800-2,000 lbs. Stack-forming wagons compress hay into large stacks designed to shed water; these stacks weigh up to 5.5 tons. Field cubers are designed to package forage into small, dense cubes that can be handled like grain. To use them, the forage must be 90% legume. Tub grinders convert hay into a ground product so it can be mixed with concentrates to form a free-flowing ration.

High-moisture systems - A field chopper takes silage or green chop forage from a standing crop or windrow, chops it into short lengths and blows it into a truck or wagon. Additionally, silage wagons can be used to transport chopped silage from the field to the silo.

Summary

The general trend within the dairy industry is toward a dry lot system with increased utilization of stored forages. Given land that is unsuitable for row crops and high costs of labor and equipment, many producers will continue to use some type of pasture system. Pastures can provide a large portion of a dairy cow's diet at a relatively low cost. Expenses rise when forages must be purchased since bulk increases transportation costs. Concentrates used to balance the ration may need to be changed because of varying forage analysis. Forage equipment is a necessary part of most dairy operations, though the type and cost of equipment varies greatly. Equipment purchase can have a major impact on the cost of the forage system used in an operation.

Credits

Ensminger, M. E. Dairy Cattle Science, 2nd ed. Danville: Interstate, 1980, pg. 115, 119-120, 126-149, 154-156.

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